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A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

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By B. E. V. Luty

The Bituminous Sandstone Area of Southwest Missouri
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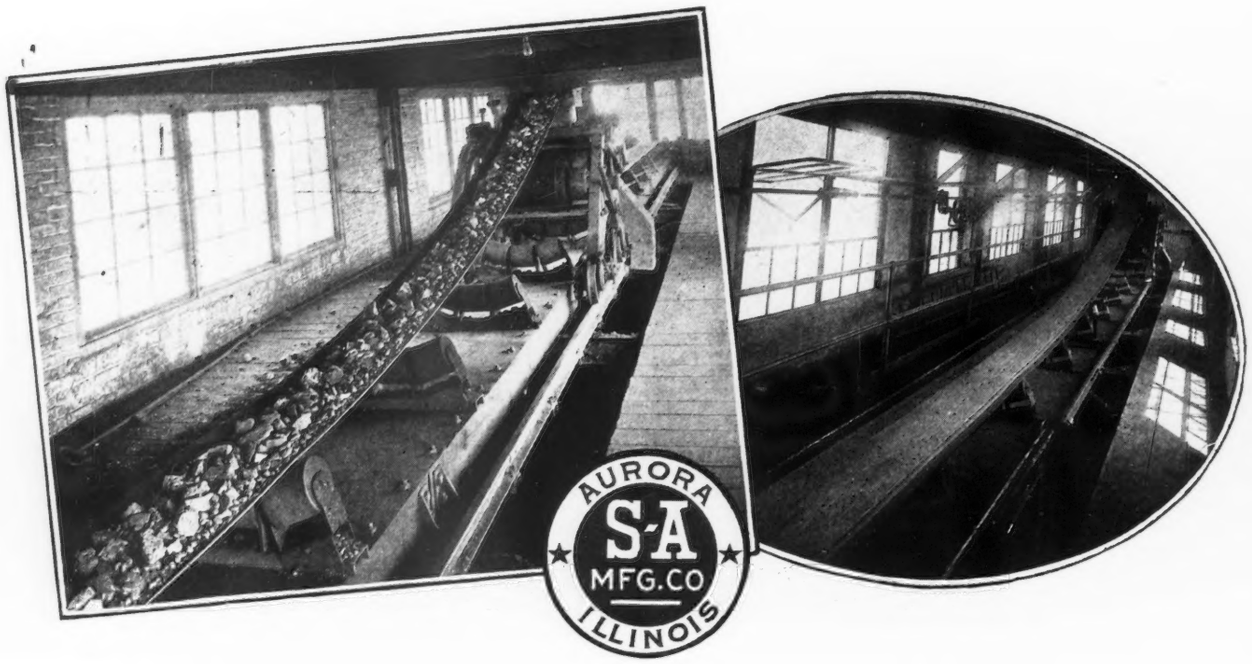

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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The Port of Missing Ships

JOYOUS is the setting forth of the gay and valiant young promoters that start for the field with shining armour and pennants a-flutter, followed by the hopes and benisons and waving kerchiefs of thousands of loyal supporters, young and fair, old and prayerful.

Subsequent events in history are not so colorful, not often chronicled. Sometimes they come back laden with spoils and largess. Often, indeed, no one remembers anything but their going out. Their supporters—those who survive—remember, but do not prate. The old have passed away; the young have got themselves new sweethearts among the promoter boys, or, chastened, have married respectable and prosy solid investments.

The startling resuscitation of forgotten stocks, the bringing forth of slinking down-and-outs, who were once the gay boys of the white lights, takes place periodically at the auction rooms. The investment journals, as a rule, never comment on this sorry event. Among the stocks which are knocked around before they are knocked down to the small gambler are many mining stocks. The mining journals are not anxious for this news, though they give much space to the same promotions when they are full of the fire and wine of youth. But a correspondent recently sent us a long list of securities sold at auction in New York and suggested that we give it some publicity, and point a moral. The list is far too long to publish. It contains mining stocks, but we note with pride that they are very much in the minority of these numerous duds that have missed fire. Still, there are some threescore of these mining stocks, among which we note at random: 10,625 shares of Gila Mountain Copper Co. *$2 lot;* 725 shares Butte Ballaklava Copper Co. *$1;* 1,500 shares Arizona Belmont Mining Co., Inc., *$1 lot;* 2,000 shares Pittsburgh and Montana Development Co., Inc., *$1 lot;* 1,500 shares Island Oil & Transport Corporation, common, *$1 lot.*

Still the wildcats that failed to grow into tigers are more numerous outside the mining field than within it. We take space for only one typical but voluminous item:

"Two hundred shares Rock Island Company, 1,000 shares Hardshell Mining Company, 200 shares Chicago Union Traction Company, 10 shares Empire City Electric Company, 3,000 shares Inez Gold & Silver Mining Company, 40 shares Eastern Stone Company, 10,000 shares Bullfrog Pioneer Raising and Milling Company, 1,500 shares Dijesto Manufacturing Company, 200 shares Davis Daly Estates Company, 100 shares Edison Phonograph Toy Company, 10 shares Delaney Heater and Rheostat Company, 750 shares Charlemont Mining Company, 8 shares Solenoid Telegraph Company, 5 shares American Pulverizer Company, 8 shares Metropolitan Electric Storage Company, 250 shares Non-Magnetic Watch Company, 210 shares Consolidated International Railway Telegraph Company and 162 shares Consolidated Railway Telegraph Company, $35 lot."

There is no need to wisely point a moral here. The moral is as old as literature and the tradition, and is celebrated in such adages as that regarding the fool and his money. Many people have played with each of these items. Some have retired richer by the interplay—generally the promoter and the broker do so; some of the stock purchasers have possibly unloaded on the ultimate goat and have avoided burning their fingers, if they were quick enough. The ultimate goat is the trusting and frequently small investor who had faith in the investment and held the securities which finally have come to the auction mart. They had the faith that promoters and boosters and shysters preach for the other fellow.

Still, in all justice, there is another and more cheerful thought that doubtless can be attached to many of these forlorn items: they may represent, some of them, gallant hopes, battles well fought, fighting even in defeat and total disaster; and though the cause be lost, the battle may have been worth while. In other words, there are men who can afford to take a fighting chance, to take a gamble with part of their funds—men whose loss will not cripple them financially, but will strengthen their knowledge and character. Without the fighting chance and the forlorn hope, Columbus would not have sailed; the "Mayflower" would not have dropped anchor at Provincetown. So let the above items, a sample of a multitude, be a warning to the small and dependent investor, while they may arouse only a smile and a benediction from the hardened warrior who snaps his fingers at danger.

More Electricity Means More Copper

OIL HAS FOR MANY YEARS been the prime source of power for driving heavy railway locomotives. The orthodox method was to burn oil under boilers to generate steam; and to use the steam to run the engine of the locomotive. The newer way is to fuel an engine of the Diesel type with oil to generate electricity; and to use the electricity to run the motors of the locomotive. In one, steam is the intermediary; in the latter, electricity. The first American-constructed locomotive of the second type has just been put in service in the New York freight yards of the New York Central Ry. Co.

The power plant of the locomotive consists of a 300-hp. Ingersoll-Rand oil engine directly connected to a 200-kw. General Electric generator. This unit furnishes current to four motors, one being geared to each of the axles. The locomotive is double-ended, with dual controls. Sufficient fuel can be carried for forty-eight hours' continuous switching service; and, in tests, the cost of fuel required averaged 20 to 26c. per hour.

At first thought it would seem that the electrical combination would be more complicated and perhaps more costly. However, the comparative high efficiency of Diesel units and of modern electrical equipment, together with the flexibility of the combination, seems to more than offset the much higher first cost of the

equipment and the somewhat higher maintenance charges.

An interesting factor from the standpoint of the metal-mining industry is the use of 3,750 lb. of copper in the generator and motor windings. In addition, the locomotive has a large copper radiator for cooling water, and contains the usual amount of copper and brass in miscellaneous parts. Every new use of copper (for this in a sense is new) means a better market for producers, who have been not especially happy for several years.

Mad or Bad?

WE KNOW of no more painful and nauseating reading than the come-on letters of Alois P. Swoboda, professional strong man and health adviser, who has for some time past made tremendous and windy onslaughts in the field of mine promotion. Many of our subscribers keep sending in letters which he has sent them, asking us to read them and see how bombastic they are. We beg them to desist, because each such letter gives us the uncomfortable feeling we are wont to experience when we get outside of Sandy Hook and the sea is rough. A correspondent from Montana, from whom we received a letter this morning, complains that he once sent Swoboda $5 for health advice, and now he must receive his mining promotion literature. Let the correspondent speak, and mark the whirlwind style of Swoboda's campaign:

"I answered one of his advertisements quite awhile ago and from then on my mail box was continually filled. At first, I believe, he wanted $25 for his information which would give me the secret of health and happiness, etc., etc. This figure, through prolonged correspondence and many long letters over many months, finally came down to $5. Many of his letters were twice the length of the attached letter. If, after receiving his information, I was not satisfied, I had only to write him and say so, giving my reasons, and he would return my money. Then, later, I received a letter which gave me the privilege of obtaining my money back by merely saying I wanted it back and giving no reasons. So—I decided to take a chance—and sent him $5; for which I received a series of lengthy letters giving advice and instructions for certain exercises to follow. I still have these, but if they were worth $5, they were worth no more, and I doubt if they were worth that.

"A short time ago, I received a letter in connection with the matter mentioned in the attached letter in which he stated that he wanted to make his pupils wealthy, etc., and to *rush* in the money for the shares—very similar to the attached letter. However, I burned this letter. That must have been about two or three months ago. Now I have received this latest letter."

The inclosed letter which Swoboda addressed to "My Dear Friend and Pupil" recites that thousands of his pupils "were lucky enough to be early in getting into the Valenciana Deep Mining Proposition with me. Hundreds of my pupils were too late for this proposition, but more than a thousand were successful in getting into it." Nevertheless, for the sake of the disappointed, and all other comers, he is going to try to get some more shares to sell, and he would let our correspondent in, and make him rich beyond the dreams of avarice, as it were. "If you really want to make yourself independently rich, then, by all means do not be too late."

He suggests delicately that his clients would even do well to scrap their business and buy the stock. "This proposition is so vast that it is worth following as a business, and thus, as an enterprise, in place of following the grocery business or the drug business or the railroad business or the farming business or any other drudgery. Through this enterprise, anyone owning five hundred shares of stock can figure on being relieved for all time from worry, work, anxiety and limitation, even if the desires of such an individual are extravagant."

This is dangerous literature. Cold-bloodedly he drums on the raw nerves of greed and ignorance:

"Life will have an altogether different meaning for you when you are independently rich. To be independently rich is a real thrill—You do as you wish—You go where you want—You buy the things you want—You help others as you desire. You are not only a better friend of yourself but a better friend of others, and, strange as it may seem, people will do more for you when you are rich than they are willing to do for you when you are not rich. They will be more agreeable to you. They will be more courteous, more considerate, more tolerant, and thus, your entire environment and conditions change for the better, and life has indeed, under such conditions, a meaning that is impossible to be understood by those who have never lived it."

Like the wind that blows on the mountain tops he boasts with limitless brazenness:

"Remember that I know the geology of mining, and I understand mining in a way that is understood by very few men, and therefore, you are having the benefit of my mining knowledge and mining experience, as well as the benefit of my business experience. In other words, you are having the benefit of an education that would require thirty years and a half million dollars to procure."

We cannot possibly blow so strong and so loud as this peculiar urban efflorescence, but, knowing something of geology and of mines, we unhesitatingly pronounce his argument to be bunk and guff and a trap only for the moronic. Nevertheless, the gentleman may be sincere. We have heard of other gentlemen who believe they were Napoleon, and of one who believed himself to be a loaf of bread.

"Moreover, we, as Swobodians, are working together under a Supreme Principle of Success, and nothing can interfere with our attainment of our desires. I full believe that I am destined to be one of the most influential of human beings, and all of this is in favor of my pupils, for, in succeeding for myself, I am succeeding for them too. Just think how rich many men could have been, had they, in their younger days, had the benefit of the success-pulling power of men like Rockefeller or Carnegie, or Morgan. I firmly and sincerely believe that those who follow me are having the benefit of that type of pulling and success power —the benefit of my 'money sense'."

But whether he be mad or bad, we strongly disapprove of mining men that avail themselves of his services to raise money.

The Fifth Estate

IN THE DECEMBER *ATLANTIC* Arthur D. Little has contributed an inspiring essay on the Fifth Estate. He says, "This Fifth Estate is composed of those having the simplicity to wonder, the ability to question, the power to generalize, the capacity to apply. It is, in short, the company of thinkers, workers, expounders, and practitioners upon which the world is absolutely dependent for the preservation and advancement of that organized knowledge which we call science."

Mr. Little, to some extent at least, restricts his Fifth Estate to persons whose creative effort is responsible for the advancement of science. He hazards the guess that the number of these persons in the world is about 100,000.

In conclusion, he states: "The world needs a new tolerance, a new understanding, and appreciation of the knowledge now at hand. For these it can look nowhere with such confidence as to the members of the

Fifth Estate. Let us, therefore, recognize the obligation we are under. Ours are the duty and privilege of bringing home to every man the wonders, the significance, and the underlying harmony of the world in which we live, to the end that all undertakings may be better ordered, all lives enriched, all spirits fortified."

Are not the engineers a part of this Fifth Estate? Or perhaps they constitute the Sixth Estate. Probably most engineers are appliers of science; nevertheless, many include the dual functions. Geological science has been measureably advanced by the efforts of the mining geologists. Metallurgists have advanced and vitalized in industry the fundamental concepts of physicist and chemists. The hand-in-hand advances made by scientists and engineers could be multiplied many times.

A national museum of engineering and industry to be built in Washington has been proposed, and the idea has been advanced to the organization stage. As part of the museum, a Hall of Fame to enshrine the busts of inventive geniuses is suggested. Undoubtedly this will lend dignity to achievement. It is a national recognition of part of the Fifth Estate.

Geology of the Engineer Mine

MR. WALTER HARVEY WEED writes us under date of Dec. 16 referring to the editorial in our issue of Dec. 13 on "Mine Examination With the Microscope." He corroborates our judgment that Professors Berkey and Colony did not draw any such inference as to the persistence of bonanza values to great depth in the Engineer mine, of British Columbia, as was given out to the press and published in the *New York Sun;* and to substantiate it he sends us a full copy of their report. He observes:

> "After reading the editorial in the Dec. 13 issue in which you very properly criticize the statement in the *Sun* concerning the petrographic work of Professors Berkey and Colony on the rocks and ores of the Engineer gold mine, near Atlin, B. C., I feel that their exact words, from their summary of the report, should be published. This report was made for and is addressed to me, but a copy was furnished my client, as the report supplements and confirms the geologic field study made by myself. Having already written an article on the geologic features of this very interesting mine, I need not give anything concerning it here, but submit a copy of the summary mentioned in order to dispel any feeling that these eminent geologists have gone beyond the evidence in their report or have as indicated by the heading of your editorial made 'a mine examination with the microscope.'"

We have read very carefully and with the greatest of interest the report which Mr. Weed sends. He is quite correct in saying that no such conclusions were contained in the report as the *Sun* had it—the report is conservative and scholarly. Presumably it was the Engineer mine's headquarters which erred in its enthusiasm, and we may perhaps pardon them for not being entirely able to interpret properly a technical report. We are refraining from publishing this entire report here, since it is too interesting to be wasted on the desert air simply as a document corroborating the situation above outlined. We may, however, summarize it briefly.

Near the mine are igneous rocks which represent a highly differentiated feldspathic magma. The wall rocks are fragmental—partly volcanic ("argillite"). The vein or veins are "crush zones" filled with quartz and feldspar (and a little carbonate), sulphides (and free gold); they are referred to as the "veindike" type. Fractures in the quartz-feldspar-sulphide veindike were filled by quartz, carbonate, sulphides and gold; these are regarded as "shrinkage cracks in a crystallizing quartz-feldspar vein-mass, which would afford a locus for the deposition of the last end-stage product and would effectually trap the gold when no other channels of escape existed." These cracks, it is believed, "represent shrinkage cracks in a crystallizing vein-mass of a more jelly-like consistency than ordinary hydrothermal solutions would have." The chief ore minerals are pyrrhotite, pyrite, arsenopyrite, stibnite, native gold carrying silver, and tetrahedrite.

These conclusions, Mr. Weed writes, are in harmony with his field work and specimens; he states that the veins are in his opinion "true veindikes." Indeed, the description above given is in line with the conclusions. It is an almost—if not quite—invariable characteristic of the gold-quartz veindike that the sulphides and gold are more persistent in their period of crystallization than is the quartz, and they therefore characteristically occur, not only in the quartz, but in little fissures that cut the quartz, whether shrinkage cracks or movement cracks; and they even pass in many places into the wall rock of the main quartz vein, to an important degree. This partial separation of quartz and metallic minerals belongs to the phenomena of magmatic differentiation.

Chance Backed by Preparation

ALTHOUGH MANY WILL AGREE with William W. Knox, president of the American Bankers' Association, who recently said: "Getting the big rewards and big positions in this world isn't merely a matter of working hard and faithfully, it is largely a matter of chance . . . ," others will want to add a few amendments.

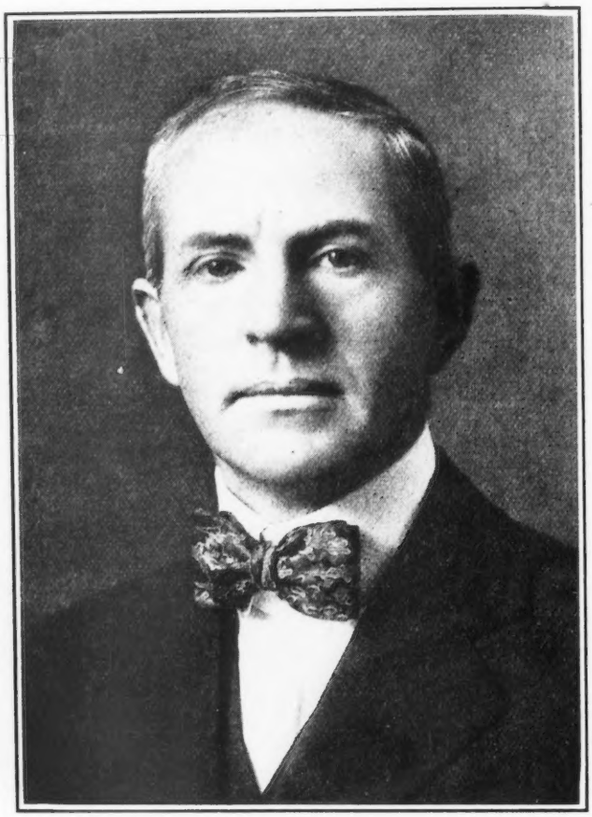
Chance and luck, no doubt, play a large share in an individual's success, but without some fundamental preparation, intimate knowledge won by observation, experience, and hard work, the individual may not be able to qualify sufficiently when the "chance" arrives, or after he may have successfully bagged the "chance," he may not know what to do with it. An unbroken mule is a chance for transportation, but considerable patience and some knowledge are required to tame the beast before it is ready for useful work. We do not advise young men to take the banker's dictum too seriously. Success results from a peculiar combination of courage and knowledge. Knowledge presupposes experience and preparation. Ability to foresee and to take "chances" are two distinct things. One is due to the power of imagination, the other to the courage element. Mere preparedness without these may not result in any more than "making-a-living success," which is not the kind in the mind of our banker.

There is also another element. The "follow-up" or sustained effort—in a word, persistence—is also fundamental. Over-night successes are sometimes heralded, but they skyrocket into oblivion if persistence is lacking. Patience also plays a part. Absence of excessive vanity, or a sense of real values, helps to consolidate success. The most successful are those who do not take their successes too seriously and who maintain a generous feeling for those who work hard and faithfully, but contribute in no small part to the success of their leaders. Many men are successful through their ability to select and stimulate their subordinates.

Mining Engineers of Note

Charles A. Mitke

FROM prehistoric times the economical extraction of ore has engaged the attention of those interested in mining. As early as the first century A. D. mining engineering had become a practical science among the Romans, and while, through the intervening ages, newer and better methods have been continually worked out, even at the present time mining men feel that there is still room for improvement in this most important and absorbing phase of the industry. The economical extraction of ore under varying conditions may be said to have constituted a life study for Charles A. Mitke. Born in 1881, a native of the anthracite district of Pennsylvania, he early familiarized himself with the methods of coal mining. Night school and classes after working hours laid the foundation of his education and permitted him to enter Yale in 1904, from which institution he was graduated in the academic course with the degree of A.B. Two years more were devoted to studying mining engineering in the Yale Graduate School and Columbia University, and then Mitke went West to accept the position of chief chemist of the Phelps Dodge coal mines at Dawson, N. M. Experiments in Dawson in the use of liquid oxygen for mining purposes, at the suggestion of the late Dr. James Douglas; visits to Bisbee in connection with the Lowell fire, resulting in Mitke's becoming a member of the Copper Queen staff; fighting mine fires at the Copper Queen, in Morenci, Coronado, Jerome, and Cananea; assisting in rescue work at the Dawson disaster of 1913; installing mechanical ventilating systems at the Copper Queen and at Calumet & Arizona, occupied the next seven years. With it all, Mitke did not lose sight of the main subject which had engaged his attention—*mining methods in all their phases;* and, realizing that many items enter into the economical extraction of ore, considerable time was devoted to experiments and investigations of efficient methods of performing various details of the work, the character of tools employed, the rapidity with which ground can be drilled, transportation problems, and studies for determination of a standard day's work, as a basis for developing contract and bonus systems. In 1917, Mitke enlarged his field by branching out as an independent consulting engineer, specializing in mining methods. As consulting engineer for the Arizona Copper company he directed all operations pertaining to ventilation and the extraction of ore under mine fire conditions. The present mining method at the United Verde Extension, planned to extract ore with a high sulphur content, susceptible to mine fires, was worked out and introduced in accord with his recommendations. The ventilating systems at all the Phelps Dodge properties, and in most of the large mines in Arizona, form a part of his work. In all, thirteen large mines owe their good working conditions to the efficient mechanical ventilating systems planned by Mitke. The ventilating system for the Santa Gertrudis mines of the Camp Bird company, at Pachuca, Mexico, was worked out in 1919, and that same year a report was also made on the method of mining the Proano Hill at Fresnillo, Zacatecas, for the Mexican Corporation. In 1921, at the request of the W. B. Thompson interests of New York, a study was made of the Flin Flon orebody in Manitoba, and late that same year Mitke was called to Bolivia to design a ventilating system for the Cia. Huanchaca de Bolivia. Mitke's book on "Standardization of Mining Methods," published by *Engineering and Mining Journal*, is in constant use in the classrooms of McGill University, Canada, and of other colleges in the States. During the spring of 1921, he delivered a series of special lectures on mining methods to students of the mining classes at the Massachusetts Institute of Technology.



CHARLES A. MITKE

Mr. Mitke is constantly engaged in working out new mining methods for the various companies with which he is connected. He is chairman of the Metal Mining Branch of the Standardization Division of the American Mining Congress; chairman of the Arizona Section of the A.I.M.E.; a member of the Institution of Mining and Metallurgy of London, and also of the Chemical, Metallurgical, and Mining Society of South Africa.

Marketing of Iron Ore and Pig Iron

How the Principal Raw Material of America's Greatest Basic Industry Is Sold

By B. E. V. Luty
Bessemer Building, Pittsburgh, Pa.

PRODUCTION OF IRON ORE in the United States in the last ten years has fluctuated between 30,000,000 and 75,000,000 gross tons (2,240 lb.). An ordinarily normal may be taken at 60,000,000 to 70,000,000 tons, supplemented by 1,500,000 to 3,000,000 tons imported, chiefly from Cuba, South America, and Sweden.

Of the United States production about 85 per cent is mined in the Lake Superior region. The remainder is scattered, and little of it sold in the open market, the major part of this being produced in Alabama and Tennessee, with blast furnaces situated near the ore deposits.

The Lake Superior region was regularly opened in 1854, by the Marquette range, the Menominee following in 1877, and the Vermilion and Gogebic in 1884. These four ranges were developed by underground mining methods. Late in 1890 outcroppings were discovered on the Mesabi range, which in 1892 became a regular producer, using light stripping operations. These deposits were very large, and deeper and deeper stripping has been the rule. Ore from the first four ranges is commonly called "Old Range" in the market, distinguishing them from Mesabi, both because they were discovered earlier and because the physical characteristics lend to the grouping, the ores being hard and lumpy, whereas Mesabi ore is fine and soft.

Pig-iron Manufacture Consumes Nearly All Ore

Iron ore used in the manufacture of paint is not of metallurgical grade. A small quantity is used in puddling furnaces as a fix. A larger tonnage is used in open-hearth steel manufacture, helping to supply oxygen for the elimination of carbon from the pig iron used in steel making; but the great bulk of the iron ore is used in blast furnaces for the manufacture of pig iron. In 1922, in the production of 26,995,173 tons of pig iron (disregarding charcoal pig iron), average consumption per ton of pig iron made was:

Iron ore (including some briquettes) tons	1.766
Scrap, scale, cinder, and other forms, ton	0.154
Limestone, lb.	969.3
Coke, lb.	2,176.3

From the five principal ranges in the Lake Superior region iron ore travels by rail to various Lake ports, except for relatively small tonnages consumed at Duluth and elsewhere. The Lake deliveries are chiefly at Lake Erie ports, from Toledo to Buffalo, and from the beginning the practice has been to name prices on Lake Superior iron ore f.o.b. Lake Erie docks. Normally, a single base price applies indiscriminately to all the old ranges and another to the Mesabi range, but a distinction is made between bessemer and non-bessemer ores. Thus there are four prices making up the Lake Superior iron-ore market, these being at the opening of the 1924 shipping season as follows, per ton:

Old Range bessemer	$5.65
Old Range non-bessemer	4.90
Mesabi bessemer	5.40
Mesabi non-bessemer	4.75

F.o.b. Lake Erie dock means, strictly speaking, at the rail of the vessel. The ore producers are vessel owners, but also employ outside vessels. The vessel rate developed for the 1924 season was 83c. total. The dock charge for ore direct from vessel to freight car is 21c., of which 13c. is paid by the vessel owner, to the rail of the vessel, and 8c. is added to the line haul. If, for instance, a blast furnace in the Mahoning or Shenango valleys bought Mesabi non-bessemer ore for 1924, the price paid to the ore company would be $4.75 per ton, f.o.b. Lake Erie dock. The ore company would pay 83c. of this to the vessel, and the vessel would pay 13c. of the 83c. to the dock company. The furnace would pay the railroad 90c. freight, out of which the railroad would pay the dock company 8c. In addition, there would be a delivery service charge at the furnace.

Some ore is piled at dock instead of moving direct from vessel to freight car. On dock ore, the 8c. from rail of vessel to car is replaced by a charge of 20c. from rail of vessel to dock pile, and there is a storage charge of 1c. per month, and a loading charge of 13c. from dock pile to car. Theoretically, the buyer of ore is expected to pay the additional cost of dock ore, but practically the ore seller is usually willing to make a concession to dispose of the ore.

Position of Phosphorus

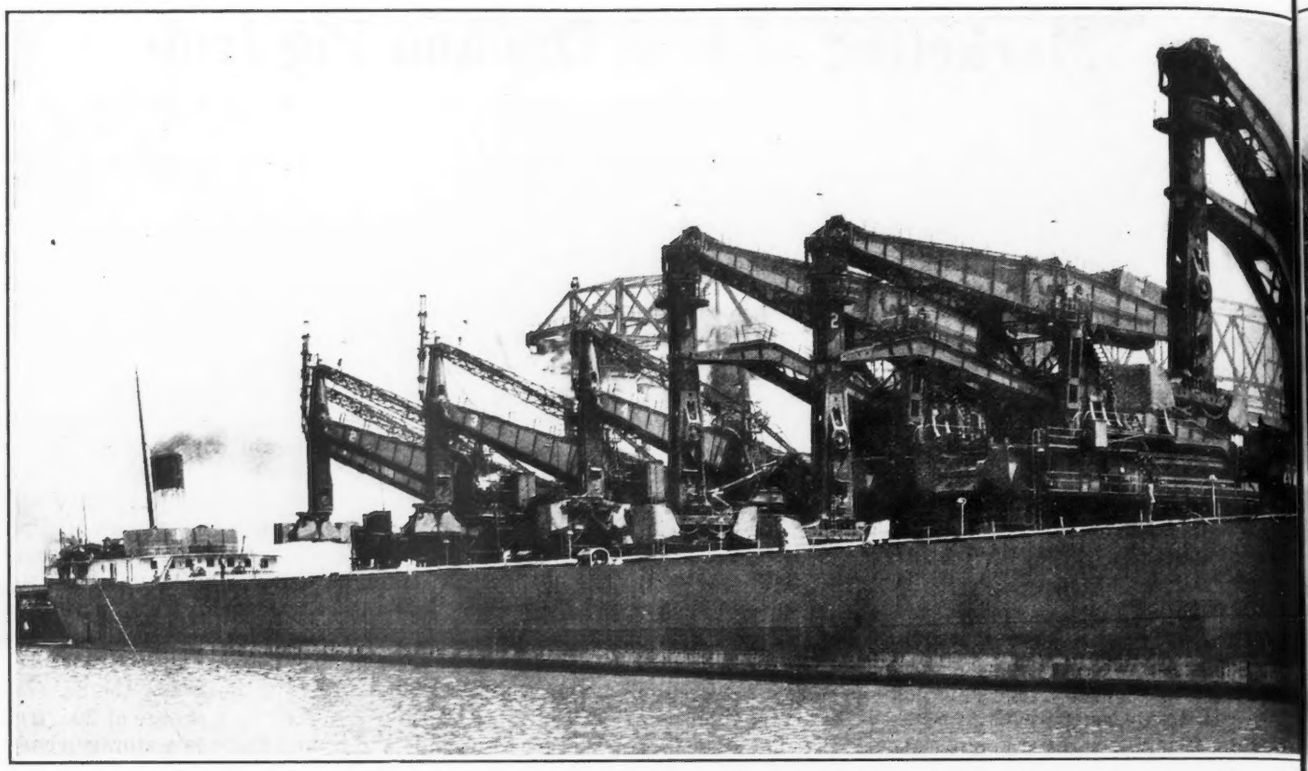
The distinction between bessemer and non-bessemer ore is in the phosphorus content. Phosphorus cannot be eliminated in the blast furnace, but remains in the pig iron, and it cannot be eliminated from the pig iron in either the acid bessemer process or the acid open-hearth process. Bessemer steel has always been limited to 0.10 per cent phosphorus, and bessemer pig iron is similarly limited. Theoretically, the ore should not contain more than 0.10 per cent as much phosphorus as iron, but variations are tolerable by mixing different ores. Practically, phosphorus is adjusted separately in fixing the actual settling price, according to a standard phosphorus table, which provides no adjustment at 0.045 per cent phosphorus content, with a scale of premiums for lower and penalties for higher phosphorus.

Since 1907 base ore standards have been 55 per cent iron content for bessemer ores and 51½ per cent for non-bessemer ores. Variations above and below are settled on a straight unit basis, except that there are concessions on ore much below base.

Cargo analyses and tonnages are reported to the Lake Superior Iron Ore Association, Cleveland, Ohio, which reports that 17,959,468 tons of bessemer ore in 1923, 29.9 per cent of all Lake Superior iron ore, had an average analysis as follows:

	Per Cent		Per Cent
Iron	54.98	Manganese	0.34
Phosphorus	0.039	Moisture	9.25
Silica	7.74		

Excluding certain particularly high phosphorus ores, with phosphorus above 0.180 per cent, 34,608,092 tons,



An Iron Ore Carrier at the Dock of the Pittsburgh

Nine unloaders constitute the equipment of this, the largest ore unloading plant in the world. The four machines at the left were the first of this type to be built, the contract having been let as early as 1898. These machines are of ten tons' capacity and are hydraulically operated. The five at the right are duplicates, each of

constituting 57.7 per cent of the total Lake Superior shipments, had the following analysis:

	Per Cent		Per Cent
Iron	51.09	Manganese	0.70
Phosphorus	0.077	Moisture	11.85
Silica	7.93		

High-phosphorus ores, phosphorus above 0.180 per cent, amounted to 3,869,686 tons, or 6.4 per cent of total Lake Superior shipments, and averaged as follows:

	Per Cent		Per Cent
Iron	50.86	Manganese	0.33
Phosphorus	0.416	Moisture	8.98
Silica	7.69		

Siliceous ores, silica 18.00 per cent and over, amounted to 1,145,344 tons, or 1.9 per cent of total Lake Superior shipments, and averaged as follows:

	Per Cent		Per Cent
Iron	42.17	Manganese	0.34
Phosphorus	0.055	Moisture	6.50
Silica	29.30		

Manganiferous ore, 2.00 per cent and over in manganese, amounted to 2,441,586 tons, or 4.1 per cent of total Lake Superior shipments, and averaged as follows:

	Per Cent		Per Cent
Iron	44.03	Manganese	6.36
Phosphorus	0.266	Moisture	11.23
Silica	6.75		

The average of the foregoing, the total Lake Superior shipments for 1923, 60,024,176 tons, was as follows:

	Per Cent		Per Cent
Iron	51.79	Manganese	0.79
Phosphorus	0.095	Moisture	10.76
Silica	8.22		

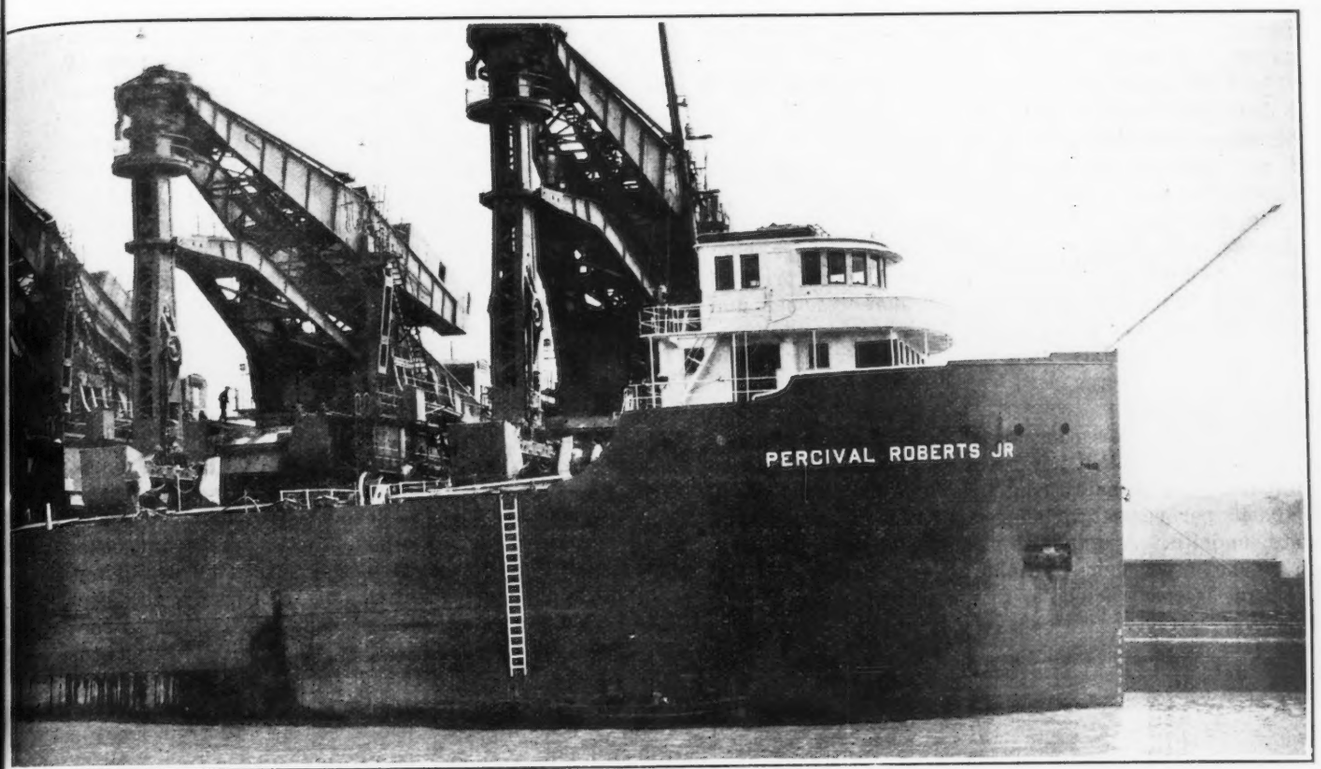
As exploration had been quite thorough years ago, there have been few discoveries of relatively rich ores in recent years, and as the better deposits are naturally worked first, and many are completely worked out, the natural trend would be for the average iron content to decrease year by year. There has, however, been no decrease in the last ten years, and this maintenance of the average is explained chiefly by beneficiation, whereby the iron content of a relatively small tonnage has been greatly raised, thus increasing the general average.

Prices Fixed for Entire Shipping Season

Until late in the nineteenth century nearly all the Lake Superior iron ore was marketed openly, and the fixing of the season prices was one of the greatest events in the iron trade in the year. The established practice was to sell for season delivery, and payment was made one-twelfth each month up to April 1 of the following year. Now that furnaces have acquired mines, and interests in operating companies and ore companies have built blast furnaces of their own, the proportion of Lake Superior ore openly marketed has continually decreased, so that today only a few million tons is sold in the open market. Other tonnage, however, is settled, as a matter of accounting, between producing and consuming companies of the same, or nearly the same, ownership.

In recent years prices established for the season have not always held well, this being particularly true by reason of shading late in the 1923 season, and the tendency in the 1924 season was to buy from time to time, often in single carload lots, instead of for the entire season, as formerly.

The enormous deposits found on the Mesabi range lying close to the surface made iron ore literally as cheap as dirt, and in fact cheaper than ordinary dirt, on account of large-scale operations. In 1898 Mesabi non-bessemer ore sold at $1.70 per ton f.o.b. Lake



& Conneaut Dock Co., Conneaut Harbor, Ohio

seventeen tons' bucket capacity and electrically operated. The first of these five was installed in 1910, and the two on the extreme right were put into commission July 1, 1924. A record was established in building these last two machines, the work being completed within six months, a task never before attempted in so short a time

Erie dock, by far the greater part of this being absorbed by freight charges, 80c. being the rail freight to dock at the head of the Lakes, while the vessel charge was hardly under 50c. Old Range non-bessemer brought only about 10c. more in that year, or $1.80, Mesabi bessemer being $2.15 and Old Range bessemer $2.75. With rather wide annual fluctuations prices rose until 1907, when Mesabi non-bessemer was $4. With a decline to $3.50 for 1908 and 1909, the $4 price reappeared for 1910, there being afterward a decline to $2.85 in 1912, an advance to $3.40 for 1913, and a decline to $2.85 for 1914 and then to $2.80 for 1915. War and post-war conditions ran the price up to $6.55 for 1920, the record high in the history of the Lake Superior region, the subsequent decline being to $4.75 for 1924.

Though iron ore is the raw material of pig iron, the actual fact, as confirmed by any statistical comparison, is that the price of pig iron fixes the price of iron ore. The ore price when developed is based upon what it appears the blast furnace man can afford to pay, according to the price he has been obtaining for pig iron. The pig iron price is what has previously been obtained, while the deliveries of the iron ore extend into the future. As pig iron makes its round trip from low to high prices and back to low again in periods usually of between one and three years, it frequently occurs that when the price of iron ore has been advanced for the new season, pig iron, made from this ore, declines, and vice versa.

But little magnetite ore has been developed in the Lake Superior region. It has been found difficult to sell, furnacemen objecting to its behavior in the furnace. In the Moose Mountain district, in Canada, some was concentrated and shipped, but the movement ended with 1,000 tons shipped in 1921. In the United States magnetic concentrates have been shipped from Babbitt, Minn., but the last of this occurred in the spring of 1924. The ore was crushed, concentrated magnetically, and then sintered.

Unit prices on Lake Superior ores are figured by adding to the regular price, which is f.o.b. Lake Erie dock, an arbitrary of 60c. This arose in the old days when the freight to Mahoning and Shenango valley furnaces was approximately 60c., the object being to equalize freight on material that was not iron. To carry out the principle correctly the arbitrary amount should now be much higher, as freights are higher. Even originally the arbitrary figure was not high enough to equalize for Pittsburgh delivery, while for Lake-front delivery it was really unnecessary.

Heavier Deductions from Leaner Ores

Another divergence from the straight unit price is that when ores run below 50 per cent the buyer is given more iron content than on the straight unit price basis. Thus, one unit below 50 is counted as 1½ units and two units are deducted for iron below 49 per cent. A 49 per cent ore is charged for as a 48½ per cent ore, a 48 per cent ore as a 46½ per cent ore, a 47 per cent ore as a 45½ per cent ore, and so on.

To illustrate, if Mesabi non-bessemer ore is $4.75, that base price is f.o.b. Lake Erie dock, on 51½ per cent ore. The unit price, which is the basis for additions to or subtractions from the base price, is figured:

$$\$4.75 + 0.60 = \$5.35$$
$$\$5.35 \div 51\tfrac{1}{2} = \$0.103883$$

For a 52½ per cent ore, this amount would be added, making $4.853883 the price of that individual ore, f.o.b.

Lake Erie dock; for a 53 per cent ore, 1½ times this amount, and so on.

For a 50 per cent ore, 1½ times the unit figure would be deducted, for a 49 per cent ore there would be an additional deduction of 1½ times the unit figure, for a 48 per cent ore there would be a further deduction of twice the unit figure, and so on.

The procedure is precisely the same for Mesabi bessemer, Old Range bessemer, and Old Range non-bessemer, there being an addition to the dock price of 60c., this being divided by 51½ on non-bessemer and 55 on bessemer ores to get the unit prices, additions or subtractions being made for ores above or below 51½ per cent or 55 per cent, as the ore is non-bessemer or bessemer.

For bessemer ores there is an adjustment for phosphorus, to be applied after the computation is made as above. The standard content of phosphorus is taken as 0.045 per cent, ore being analyzed in its natural state, undried. A standard phosphorus table, ranging up to 0.070 per cent phosphorus and down to 0.005 per cent, is constructed on the principle shown in the following extract:

Phosphorus	Rate of Progression	Phosphorus Value
0.050	0.0100	—0.0450
0.049	0.0095	—0.0350
0.048	0.0090	—0.0255
0.047	0.0085	—0.0165
0.046	0.0080	—0.0080
0.045	0.0000	0.0000
0.044	0.0080	+0.0080
0.043	0.0085	+0.0165
0.042	0.0090	+0.0255

Thus for bessemer ore 0.042 per cent phosphorus, 2.55c. would be added to the per ton price.

Base Price—Lake Erie Ports

	Old Range	Mesabi Range
Bessemer 55 per cent	$5.65	$5.40
Non-bessemer 51½ per cent	4.90	4.75

Pig Iron

Pig iron is the product of the iron blast furnace. The metal has outgrown the form indicated by "pig" (sow and pigs produced by casting in sand), for in 1924 61 per cent of all the pig iron made was delivered and used molten from the blast furnace, and 30 per cent was cast in chills, leaving less than 9 per cent to be sand cast.

From three-fourths to four-fifths of the pig iron made is used in the manufacture of steel, which consists chiefly in reducing the impurities of the pig iron, mostly carbon, which makes pig iron brittle. About 15 per cent is used in making gray iron castings, by simple mixing and melting, chiefly in the foundry cupola, and about 4 per cent is used in making the so-called "malleable" castings, in which the carbon is somewhat reduced. Less than 1 per cent is used in puddling, to produce wrought iron. Chiefly in the decade of the eighteen-nineties steel making supplanted puddling, and what little wrought iron is now produced is made chiefly from scrap. The bulk of the steel-making iron is produced by the steel makers themselves.

To produce one ton of pig iron requires, on an average, the assemblage of 1.9 tons of ore, or ore, scrap, scale and other waste material; 0.4 to 0.5 ton of limestone, and one ton of coke, a total of more than three tons. When the ore is lean, proportionately more must be used, while the amount of limestone and coke increases still more, except in the case of an ore being lean through being self-fluxing. Accordingly, the site of the blast furnace is determined with respect to the raw materials required rather than with respect to the location of the market for the pig iron. It chances that in the United States much latitude of choice exists, on account of the use of coking coal from southwestern Pennsylvania, Virginia, and Kentucky, together with iron ore of the Lake Superior region, in Minnesota, and Michigan. Various sites have been selected where the fuel and the ore can be brought together economically.

Importance of Southern Production

The Birmingham district, northern Alabama, with a part of Tennessee, is self-contained as to ore, fuel, and limestone, and produces 7 to 8 per cent of the total pig iron of the United States. There are various minor districts, and along the Atlantic seaboard imported ores are used largely, with fuel brought from further west. About 85 per cent of domestic pig iron is made from Lake Superior ores, chiefly in western Pennsylvania, Ohio, Indiana, and Illinois. A relatively small quantity of pig iron is made from Lake Superior ores in Michigan, Wisconsin, and Minnesota.

Lake Erie Prices of Iron Ores—Season of 1924

Nat. Iron	Old Range Bess.	Old Range N. B.	Mesabi Range Bess.	Mesabi Range N. B.	Premium Phos.	Premium Amt.	Penalty Phos.	Penalty Amt.
44	3.775006	3.511652	3.599998	3.399521	.045	.0000	.045	.0000
	.227272	.213592	.218182	.207766	.044	.0080	.046	.0080
45	4.002278	3.725244	3.818180	3.607287	.043	.0165	.047	.0165
	.227272	.213592	.218182	.207766	.042	.0255	.048	.0255
46	4.229550	3.938836	4.036362	3.815053	.041	.0350	.049	.0350
	.227272	.213592	.218182	.207766	.040	.0450	.050	.0450
47	4.456822	4.152428	4.254544	4.022819	.039	.0555	.051	.0555
	.227272	.213592	.218182	.207766	.038	.0665	.052	.0665
48	4.684094	4.366020	4.472726	4.230585	.037	.0780	.053	.0780
	.227272	.213592	.218182	.207766	.036	.0900	.054	.0900
49	4.911366	4.579612	4.690908	4.438351	.035	.1025	.055	.1025
	.170454	.160194	.163637	.155824	.034	.1155	.056	.1155
50	5.081820	4.739806	4.854545	4.594175	.033	.1290	.057	.1290
	.113636	.106796	.109091	.103883	.032	.1430	.058	.1430
51	5.195456	4.846602	4.963636	4.698058	.031	.1575	.059	.1575
	.113636	.106796	.109091	.103883	.030	.1725	.060	.1725
52	5.309092	4.953398	5.072727	4.801941	.029	.1880	.061	.1880
	.113636	.106796	.109091	.103883	.028	.2040	.062	.2040
53	5.422728	5.060194	5.181818	4.905824	.027	.2205	.063	.2205
	.113636	.106796	.109091	.103883	.026	.2375	.064	.2375
54	5.536364	5.166990	5.290909	5.009707	.025	.2550	.065	.2550
	.113636	.106796	.109091	.103883	.024	.2730	.066	.2730
55	5.650000	5.273786	5.400000	5.113590	.023	.2915	.067	.2915
	.123636	.106796	.119091	.103883	.022	.3105	.068	.3105
56	5.773636	5.380582	5.519091	5.217473	.021	.3300	.069	.3300
	.133636	.106796	.129091	.103883	.020	.3500		
57	5.907272	5.487378	5.648182	5.321356	.019	.3705		
	.143636	.106796	.139091	.103883	.018	.3915		
58	6.050908	5.594174	5.787273	5.425239	.017	.4130		
	.153636	.106796	.149091	.103883	.016	.4350		
59	6.204544	5.700970	5.936364	5.529122	.015	.4575		
	.163636	.106796	.159091	.103883	.014	.4805		
60	6.368180	5.807766	6.095455	5.633005	.013	.5040		
	.113636	.106796	.109091	.103883	.012	.5280		

The rate of pig-iron production varies widely from time to time, it being no uncommon thing for it to be twice as much at one period as at another. This tendency to fluctuate is due chiefly to two influences: First, iron is largely a construction material. Second, many manufacturing and fabricating processes are involved—in most cases between the iron and the article of utility in its final employment. All along the line there is a tendency at one time to accumulate stocks and at another time to liquidate. At a given time, for instance, a blast furnace may be idle, but shipping pig iron from its stocks to stove foundries, while stove foundries may be reducing their stocks of stoves and retail dealers may be reducing theirs, the buying of stoves by ultimate consumers continuing while the production of pig iron has ceased at the furnace. At other times manufacturers and dealers all along the line may be stocking up.

On account of these fluctuations, the continuous growth of pig-iron production is best shown by decennial totals, and it chances that the grouping into decennial periods ending in "3" distributes the good and bad years in iron production with particular uniformity. Production in tons of 2,240 lb. has been as follows:

Ten Years Ended		Ten Years Ended	
1833	140,000	1883	3,060,190
1843	255,000	1893	6,810,033
1853	575,000	1903	12,527,230
1863	726,349	1913	24,395,566
1873	1,598,092	1923	32,256,964

The "rule of doubling" in pig-iron production every ten years, enunciated more than a third of a century ago by Abram S. Hewitt, an iron maker and once Mayor of New York, worked out well until the last decade, when it broke down, presumably because the iron industry had then grown so large that such a geometrical progression simply became impossible.

On the other hand, there have been such fluctuations as 9,202,703 tons produced in 1890 and only 6,657,388 tons in 1894, and 39,434,797 tons in 1916 and only 16,688,126 tons in 1921. However, the 1923 production, 40,361,146 tons, broke the 1916 record by a small margin.

Fracture and Chemical Analysis Used in Grading

For many years foundry pig iron was graded by fracture, but this was more or less an indication of chemical composition, and in recent years grading of pig iron of all classes has been entirely by chemical analysis.

From three-fourths to four-fifths of the pig iron is used in making steel. The composition required is determined by the steel-making process to be employed, and by the character of steel desired, these two requisites being interlocked, as the character of steel determines to an extent the steel-making process employed.

In all pig iron the carbon is substantially uniform, a trifle over 4 per cent, and this carbon is a necessity in the blast-furnace process, so that carbon is not considered in analysis. It makes pig iron—and iron castings—brittle. With carbon under 0.20 per cent, steel is soft. Above 0.20 per cent, it is hard, being merely hard steel until above 0.50 per cent it becomes capable of taking a temper. Above 2 per cent the material is commonly called special cast iron rather than steel, up to say 4 per cent, when the material is an ordinary iron casting.

The important elements in a pig-iron analysis are silicon, phosphorus, sulphur, and manganese.

Silicon is controlled partly by selection of ore, partly by operation of the blast furnace, the furnace running hot producing higher silicon iron from the same ores.

In the acid bessemer steel-making process, in which cold air is blown through the bottom of a converter lined with an acid refractory and containing molten pig iron, silicon and carbon are removed by combustion and a certain amount of silicon is requisite to produce heat. The iron required is called bessemer iron. By custom, the silicon limitations are 1.00 to 2.00 per cent, but as a matter of fact silicon can run somewhat under 1.00 per cent, while 2.00 per cent silicon prolongs the blow by furnishing too much heat.

The same material, bessemer pig iron, is used in making steel by the acid open-hearth process, where a flame produced by gas from regenerators plays over the bath of molten pig iron.

Requirements as to Impurities

Unlike silicon, phosphorus is absolutely beyond control in the blast furnace, and it is also beyond control in the acid bessemer and the acid open-hearth steel-making processes. In steel, phosphorus is always limited to 0.10 per cent; hence an ore must be selected which contains less than this proportion of phosphorus. Such ores are called bessemer ores, though the bessemer pig fron thus produced is used not only in the bessemer process but also in the acid open-hearth process.

When phosphorus exceeds the bessemer limit it can be used only in steel making by reducing it, for which a basic addition is necessary; hence the lining must be basic. The basic bessemer process is not practised in the United States. The basic open-hearth process has now by far the largest vogue of any steel-making process in the United States. It eliminates phosphorus, but this takes time, and the lower phosphorus irons are preferred. In Alabama the specification limits phosphorus to 1.00 per cent. Iron made from Lake Superior ores does not run over 0.40 per cent, and many furnaces will guarantee phosphorus not over 0.25 per cent. The basic open-hearth process eliminates silicon, but only slowly; hence silicon is limited to 1.00 per cent.

Sulphur is objectionable in all cases, and in practically all pig iron is limited to 0.05 per cent. It can be largely eliminated in the blast furnace, but only within limits, and coke containing more than 1.00 per cent sulphur is objectionable. Usually there is very little sulphur in the ore.

Thus the two principal steel-making pig irons are bessemer pig iron and basic pig iron, bessemer iron being limited to 0.10 per cent phosphorus and 1.00 to 2.00 silicon, though the lower silicon is preferable, whereas basic iron allows more than 0.10 per cent phosphorus but limits silicon to 1.00 per cent. Both grades are limited to 0.05 per cent sulphur.

There is also a "low-phosphorus" iron, used in the acid open-hearth steel-making process to produce steel particularly low in phosphorus. This iron is limited to 0.04 per cent in both phosphorus and sulphur. A special "washed metal" has still lower limits.

For ordinary gray-iron foundry practice the analysis of the casting is determined by the analysis of the pig iron, scrap, and coke used in the cupola. As in steel-making pig iron, sulphur is limited to 0.05 per cent.

Phosphorus more commonly varies from 0.40 to 0.80 per cent, but some districts show other ranges, according to the ores available.

Many Grades of Foundry Iron

Silicon is the controlling element in the grading of foundry pig iron and was the chief element determining the fractures by which pig iron was formerly graded, the higher silicon producing the higher grades of pig iron, chiefly in that they are more fluid and will permit of larger proportions of scrap being melted with the iron.

In foundry iron the standard is No. 2, containing 1.75 to 2.25 per cent silicon. The standard variation between grades is 0.50 per cent. In some districts the grade above No. 2 plain is called No. 1; in others it is called No. 2X; whereupon there is a No. 1X, still higher. Below No. 2 plain there are merely No. 3 and No. 4, the last being little in vogue. Thus there are the following grades in foundry pig iron:

	Silicon Content in Per Cent		Silicon Content in Per Cent
No. 1X	2.75-3.25	No. 2	1.75-2.25
No. 1	2.25-2.75	No. 3	1.25-1.75
No. 2X	2.25-2.75	No. 4	.75-1.25

Above 3.25 per cent silicon iron is classified as high silicon and above 7 per cent it is called ferrosilicon.

Forge pig iron is a low grade, equal to or below No. 4 foundry iron, formerly much used in puddling, and then of rather uncertain analysis.

Malleable pig iron, used in making malleable iron castings and formerly erroneously called "malleable bessemer," runs 0.10 to 0.20 per cent phosphorus and under 0.05 per cent sulphur, like other pig iron, and has various silicon limits according to the requirements of the consumer, these limits generally ranging within 0.75 and 2.00 per cent.

Manganese is specified by the buyer in the case of malleable pig iron. In other foundry irons and in steel-making iron the manganese is not important, being more or less desirable. The amount depends upon the ore available, and the buyer knows approximately what to expect in iron coming from a given district. In the major part of the pig iron produced manganese runs approximately 0.50 to 1.00 per cent.

In the case of steel-making irons the analysis is simple and there is little room for doubt, except that a buyer would object to receiving large deliveries of iron running close to the upper limit in silicon.

In foundry iron there are various fine points, determined by the exact relations between silicon, phosphorus, sulphur, and manganese, which the consumer, if he understands them, will take care of by making purchases from two or three furnaces with whose product he is familiar. With small consumers, not so well acquainted with details, the experienced pig iron salesman will frequently make selection of the iron he delivers, to suit it to particular requirements, without divulging his reasons, thereby aiming to hold a customer for his particular brands.

Pig-iron sales are all made per gross ton of 2,240 lb. The usual terms of payment are thirty days net, with one-half of 1 per cent off for cash in ten days.

Both Prompt and Forward Sales Made

Quantities and periods of delivery vary widely, according to the state of the market. When forward deliveries are sold the period is usually a quarter of a year at a time. Before the war it was common for iron to be sold two or three quarters ahead.

The pig-iron market always moves in great price swings. When prices are advancing sales are made farther and farther ahead. When the advance ceases, buying also practically ceases, and as contracts are being liquidated market activity is confined to small spot lots.

Generally speaking, each pig-iron producing district makes it own market prices, but as there are twilight zones between districts a price movement in one district affects another more or less. The principal producing districts are the Mahoning and Shenango valleys, on each side the Ohio-Pennsylvania state line and commonly called "the Valleys," and the product is called "Valley iron," as a market, though not a grade distinction; eastern Pennsylvania, Buffalo, Cleveland, Chicago, Virginia, and Birmingham, the last named including some furnaces in Tennessee.

In some districts the market price is commonly f.o.b. the furnace; in other districts it is delivered at an important consuming point. With Valley iron the market is f.o.b. Valley furnaces, all these furnaces having the same freight rate to Pittsburgh and other points at all removed. The eastern Pennsylvania market, on the other hand, is commonly quoted delivered Philadelphia and delivered New York City. The three districts Buffalo, Cleveland, and Chicago serve chiefly consumers in their respective immediate vicinities. Buffalo quotes f.o.b. furnace, Cleveland quotes delivered, and Chicago usually quotes f.o.b. furnace. In Cleveland there is a uniform switching charge between the furnaces and the various consumers of 50c. per ton; in Chicago the corresponding charge is 61c. In all three cases, however, the furnaces may in periods of light demand make sales to more remote points at lower f.o.b. furnace prices than they seek to maintain in their own private markets. Though "Southern iron," from the Birmingham district, is sold delivered, there is usually a uniform f.o.b. furnace basis.

Price-control Factors

There has been no regularity about price fluctuations. In some years prices may move as much in dollars as they do in dimes in other years. Prices are made more by demand or lack of demand than by variation in cost of manufacture. The price of pig iron is much more likely to control the price of iron ore than vice versa.

In the case of Connellsville coke, before the war coke tended to rise and fall with pig iron, and "ratio" contracts for coke were common, the settling price of coke deliveries in each month of the contract being fixed by the prevailing pig-iron price. In recent years various exigencies have at times given the Connellsville coke producer a more commanding position, whereby coke has sometimes advanced and forced pig iron up. The wage cost at the blast furnace is small, generally under a dollar a ton, so that wages at blast furnaces have little to do with the price of pig iron. Wages at coal mines, coke works, and iron-ore mines, and transportation rates, are the chief factors in varying the cost of producing iron.

In actual practice there is little connection between cost and selling price. The merchant furnaces sometimes lose money. With advancing selling prices and increasing costs they may be losing money on deliveries on old sales and making large per-ton profits on their latest sales.

The Bituminous Sandstone Area of Southwest Missouri

Opportunity for New Industrial Development Apparently Exists, but Treatment Process Is Lacking

By C. W. Hall

Superintendent, Yoquivo Development Co., San Juanito, Chihuahua

C. W. Hall

SOME TIME AGO I had occasion to make a trip of inspection through what is known as the "bituminous sandstone belt" of southwest Missouri. The data from which these notes are prepared were gathered mostly from local sources, and from observations that I was able to make on a trip of but a few days' duration, with visits only to portions of the field.

The area covered by this sandstone is made up of a part of the northern part of Barton and the southern part of Vernon counties; north of Lamar, in Barton, and south of Nevada, in Vernon. The field has been estimated to have an area of from twenty to thirty square miles. The sandstone is locally thought to be strata of the Bartlesville formation, the same that has produced oil in such quantities in Oklahoma; this, however, is a supposition only, and has not been confirmed.

The deposit varies from 6 to 30 ft. in thickness and has an overburden of from 0 to 30 ft. The bituminous content varies from 5 to 15 per cent. The sandstone is dark gray in weathered specimens (indicating low bituminous content), and varies from brown to deep black in high-grade rock. Much of the fresh rock, upon exposure to the sun, oozes a sticky, black substance resembling tar. It is a soft and much jointed rock, and is easily drilled and broken. The overburden is a sandy soil, and is underlain by soft shale, which requires little or no blasting for stripping operations.

The existence of this bituminous formation has been known for many years, but little has been done to prospect or develop the area. Data available as to proven tonnages or bituminous content are scant and incomplete. The Missouri State Geological Survey (situated at Rolla) has had representatives from its staff over the field for cursory observations, but as yet has published no data that would be of special value to anyone considering a commercial venture in the district.

In going into the field a start may be made from either Nevada or Lamar, where automobiles can be hired and men who know locations of different outcrops and test pits may be found to show one about. However, it might be stated here that any one going into the field on preliminary work with the expectation of finding concrete evidence of proven areas, with definite tonnages of known bituminous content, will be disappointed. Most of the data must be deducted from visible outcrops and from information gleaned from local people. A majority of the few test pits and wells that have been excavated are either caved or are full of water, and do not offer the evidence that the observer seeks. Some churn drilling has been done, but data from the logs of the holes are available only to those who did the work.

The most important known areas noted thus far are the following:

1. The Bellamy field, in Vernon County, south of Bellamy, close to the Barton County line and north of Lamar. The deposit is known to underlie portions of S. 24, 26, and 27, T. 34, R. 30. The boundaries have not been definitely delineated, but it is safe to estimate that there are several million tons, and the indicated general distribution would add to the extent. The deposit varies in thickness from 10 to 30 ft. and has an overburden of from 0 to 10 ft. The bituminous content is said to be about 13 per cent, the highest in the region. It is 6 miles from the railroad, which circumstance is naturally an adverse factor.

2. Eight miles west of Bellamy, in Vernon County, there is an outcrop visible in a stream bed, which shows a thickness of about 20 ft., an overburden of from 20 to 30 ft., and which is said to have a bituminous content of about 5 per cent. It is one mile from the railroad.

3. Close to Deerfield, in Vernon County, there is an outcrop visible for several hundred feet. It has a thickness of about 7 ft. and an overburden of 7 ft. The bituminous content is about 6 per cent. The deposit is two miles from the railroad.

4. North and west of Moundville, in Vernon County, there are several exposures, which indicate thicknesses varying from 6 to 12 ft. The overburden is about 10 ft. thick, and the bituminous content about 7 per cent. The distance from the railroad varies from one to three miles.

5. Five miles northwest of Moundville, in Vernon County, on the Drywood River, there is an extensive deposit, which is about 10 ft. thick. The overburden is from 4 to 10 ft. thick, and the bituminous content is about 6 per cent. At present a small experimental mill is operating on rock from this deposit, working along the line of producing an asphaltic road-material by adding a small amount of bituminous cement. No extraction of oil is made.

6. Two miles north of Moundville a small churn drill is in operation, drilling shallow test holes through the bituminous sandstone, which is encountered at from 8 to 10 ft. It averages about 11 ft. in thickness and has a bituminous content of 6 per cent.

7. North of Lamar, in Barton County, there are several visible outcrops along creek and river beds, which show thicknesses varying from 6 to 12 ft., and overburden from 6 to 10 ft. The bituminous content is about 7 per cent.

Outside of the Bellamy field, where more work in prospecting has been done, the areas mentioned above show no more than an outcrop here and there and offer nothing definite from which to base estimates. Although the deposits vary greatly as to extent and grade, there are indications that large areas are well underlain by this sandstone and that definite tonnages of dependable grade may be developed by thorough prospecting, data being obtained by churn drilling or sinking test pits, much the same as has been done in developing the large, low-grade metalliferous deposits of this country. Nothing should be left to chance or assumption.

Hundreds of people, including many engineers with varied ideas, patent processes, and schemes of exploitation, have been over the field, but so far nothing has come of it, and no venture on a commercial scale has yet developed. At present, many men are going over the country securing leases and hoping that a boom, such as an oil-field rush, is imminent.

Experimental tests have been made by different engineers on samples from various parts of the field, and from a study of some of the resulting data it is evident that the bituminous content of the sandstone is indefinite. Some tests show that the oil that may be extracted has a paraffine base; others, that it has an asphaltic base; and still others, that it has a mixed base. Experiments have been made which show that all of the oils may be extracted, leaving practically no residue containing bitumen; other experiments show that some of the oil may be extracted, leaving a residue, which, by the addition of bituminous cement, will result in a material suitable for road building; still others show that it is best to convert the sandstone directly into a road material by the addition of some bituminous cement, without extraction of oil.

Although the results of some of the experimental work are apparently discordant in the extreme, it is safe to say that the sandstone can be made to yield oils of a high grade, and some kerosene and gasoline, if a suitable process, applicable on a commercial basis, can be worked out.

If sufficient tonnages can be developed to warrant working on a large scale, by stripping and mining with steam shovels, mining costs comparable to any in the country should be attained. Adjoining this field strip-pit coal mine operation is being carried on with remarkably low mining cost.

The hitch at present in the development of the field is the apparent lack of a treatment process for the extraction of the oil from the sandstone. If this is not yet possible it seems to me that here is an opportunity for the creation of an industry by mining and working the sandstone directly into a suitable asphaltic road material. The field is ideally situated to supply the market for the road-building industry of Missouri and Kansas—an industry that is expanding rapidly.

The land over the field is held largely by farmers, in small tracts. The present value is around $60 per acre, and I doubt if much could be obtained for less, and the price might be somewhat higher. The present attitude of the owners of the land is to lease it for mining on a royalty basis. The prevailing royalty is 10c. per ton, which is much too high. Mining operations would destroy the land for agricultural purposes and it should be more satisfactory and cheaper to buy the ground outright, but this expenditure is hardly warranted until prospecting has been done to block out proven tonnages.

Probably the most satisfactory method for prospecting the sandstone is with a small churn drill, such as is used in the district for sinking shallow water wells. Drilling could be supplemented by test pits, sunk at occasional intervals, or where the overburden is very shallow, for corroborating evidence and to secure additional geological information. A hand auger would not be satisfactory for prospecting the ground, because of a hard shell of sandstone a few inches in thickness overlying the bituminous strata.

Final operations will probably be on a large scale, of hundreds and perhaps thousands of tons per day. If based upon the extraction of the oil from the sandstone, refineries could be included within the treatment plant and the complete cycle, from crude rock to the refined petroleum products, could be carried out on the ground. Expansion of operations could be gradual, from one unit to another, the units not necessarily being adjacent, but erected on the different areas, at the source of the mined material.

For capital considering a venture into the field a logical procedure would be:

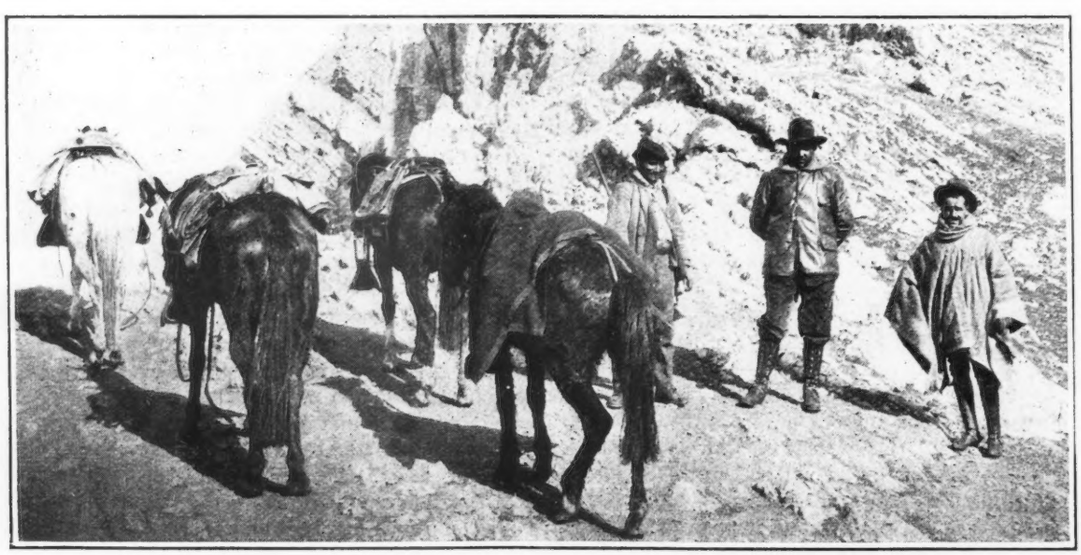
1. Leasing of sufficient promising areas, with an option to buy (if possible) later.

2. Thorough prospecting of these areas by churn drilling and sinking test pits, under supervision of competent engineers to keep accurate logs of the holes and pits, much the same as systematic drilling is done in the large, low-grade ore deposits.

3. Correlation of data, including geology, assays, and tonnage estimates.

The data thus obtained should not entail excessive expenditure.

In the Andes of Peru—On the Pass



Continental Divide, about 2 miles from Mina Ragra. Elevation about 16,500 ft.

Early Mining in Japan

A Study of the Origin and Development of Ancient Practices in Use Before the Adoption of Western Civilization

By Keijiro Nishio
Tokio, Japan

IN MY PAPER on mining in Japan[1] which I contributed to the *Transactions* of the A.I.M.E. in 1912 and which was translated into several languages, I discussed the history of mining. Since then, progress has been made in archaeological research, and historical studies have brought new facts to light. Mr. Manchester's article entitled "Mining in Old Japan," which appeared in the May 19, 1923, issue of *Mining Journal-Press*, was interesting, but dealt mainly with the later part of the Tokugawa regency (1603-1867). The present paper is intended to supplement my earlier article as well as that of Mr. Manchester.

Use of Metals by Prehistoric Tribes[2]

Before the Yamato tribe came into the islands two different tribes had already settled in Japan, one the Ainu and the other the Yayoi or Izumo. Abundant reminders of the Ainus are found in northern Japan, rarely in the middle part, and less rarely in the southern part of Kyushu. The Yayoi tribe has left most numerous traces in the middle part of the islands, but very few in the north.

Heretofore, the relics belonging to this prehistoric period that were found were mostly tools made of stone, animal bones and horns, and seldom glass beads, bronze arrow heads or ancient coins of China. Recently the exploration by Prof. H. Nakayama brought to light swords and halberds of bronze, grains of copper molds for swords, cinnabar, mirrors, pieces of iron, iron slag, and Chinese coins and glass beads. These were found in remains of the Yayoi tribe in northern Kyushu.

From these discoveries we know that the tribes of the prehistoric period were using primitive stone wares on one hand, and metal wares on another, and also casting weapons of bronze and making iron wares. Thus the period was both a stone and a metal age.

Professor Nakayama proved that the mirrors were all of ancient Chinese make, of fine quality, and belonged to the latter part of the Han dynasty (206 B.C.-8 A.D.) or to the Wang Mang dynasty (9-22 A.D.). The coins were current during the Wang Mang dynasty or in the early part of the After-Han dynasty (25-220 A.D.). The glass beads, it was decided, were made in China in the reign of Wu-ti, of the Han dynasty (140-87 B.C.). It was quite evident, therefore, that the prehistoric tribe in northern Kyushu was communicating with China at that time.

Some of the analyses of the metal in the swords and halberds were as follows: A bronze halberd, from Antoku, in the Tsukushi district, Chikuzen, showed 76.60 per cent copper, 14.13 per cent tin, 1.32 per cent lead, 4.90 per cent antimony, and 3.93 per cent nickel. A bronze sword, from Kanamaru, in the Kurate district, Chikuzen, showed 83.13 per cent copper, 8.92 per cent tin, 7.83 per cent lead, and a trace of silver.

In northern Kyushu, copper is now mined at Ino, Chikuzen, and Yokoyama, Chikugo. In the prehistoric period the barbarous people were thus able to get native copper from the outcroppings of the ore deposits. Tinstone is also found in Satsuma, Bungo, and Hyuga, but the prehistoric people could hardly have got it from there, as the localities must have been inaccessible at that time. Therefore, it is likely that tin was brought from China for casting weapons.

The iron slag found is porous in texture, dark black in color, metallic in luster, and heavy. Its chemical composition, in percentages, is as follows:

Slag	Iron	Manganese	Silica	Sulphur	Phosphorus	Titanium	Coppe
A.....	53.83	0.47	15.60	0.18	0.04	3.13	Trac
B.....	56.40	Trace	8.76	0.20	0.08	0.29	Trac

As the slag contains considerable iron and little silica, it probably was produced by a primitive method of smelting iron ore. As the sulphur content is low, the original ore seems not to have been a sulphide. Likewise, it seems that it was not manganiferous and that manganese flux was not used in smelting. The small amount of phosphorus indicates that the material was not bog iron ore. The abundance of titanium, however, indicates that the ore was probably magnetic sands. Such sands could have been obtained from alluvial deposits, which were derived from the weathering of granite, which occurs on the boundary of Hizen and Chikuzen.

Cinnabar was found lining the inner side of burial jars or as grains in the latter. Mercury ore is now found in Hyuga and Hizen. It is likely, however, that the cinnabar used was brought from China.

The prehistoric tribes thus lived in an age of stone and metals, but it remained for the Yamato tribe to introduce iron tools, which they brought with them when they came to Japan from Asia.

Mining Methods in Ancient Japan[3]

I could find in our literature no records about old methods of mining in our country. The Tsushima silver mine (now worked for zinc ore) was discovered in the reign of Emperor Tenmu, 674 A.D., and continued its prosperity for 400 years. The Tsumo copper mine, Iwami, was discovered in 881 A.D. and produced considerable copper for coinage. Upon personal examination of both mines I could find no indications of any of the old methods of mining, because the mines had been worked for such a long period that any such traces had long ago disappeared. I was obliged to study old mining districts throughout the country. As a result of this work I was able to discern three methods of mining that had formerly been used.

The Ōtani gold mine, in the Ōno district, in Hida, was opened by Mozumi Sōtei in 1591. The gold veins strike N. 20 deg. E., dipping 70 deg. eastward through quartz diorite. In this region there are several zones in which shallow ditches are found running in the same direction as the strike. These ditches are evidently all that is left of trench workings of an earlier day.

[1]Nishio, K.: "Mining in Japan," *Trans.*, A.I.M.E., Vol. XLIII, 1912.

[2]Nishio, K.: "The Utilization of Metals by Prehistoric Tribes in Japan," Journal of the Mining Association of Japan, Dec., 1922, No. 454, pp. 809-814.

[3]Nishio, K.: "Ancient Mining Methods in Japan," J.M.A.J., May, 1921, No. 435, p. 284-290.

In the Ōya gold mine, in the Motoyoshi district, in Rikuzen, many narrow gold veins are found traversing the Tertiary clay slate formation, with a strike of N. 20 to 30 deg. E. As the outcroppings are entirely weathered, it was advantageous to work in open cuts,

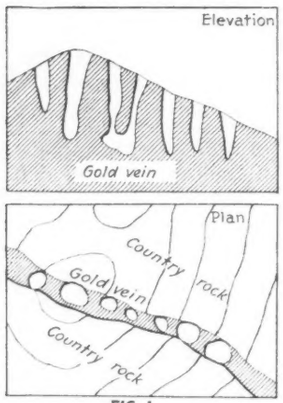


FIG. 1

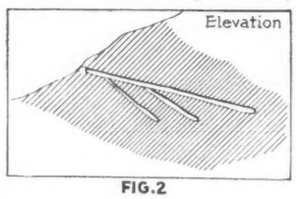


FIG. 2

Fig. 1—Sketch showing method of mining by means of pits. Fig. 2—Illustrating method of mining by diagonal slope

and the remains of trenches are seen along the outcrops. The relation of the trenches and veins has been disclosed by drifting which was done later along the veins. The trenches were probably dug by miners belonging to Date Masamune, the Daimyō of Sendai, in 1596.

The Kanazawa gold mine, in the Suwa district, in Shinano, where veins of auriferous quartz occur cutting across the formation of Paleozoic slate, was opened by Takeda Shingen, the Daimyō of Kai. After his successor, Katsuyori, was killed, in 1582, his subjects worked the mine for seventeen years to support themselves. Among the ruins I found several trenches running in the same direction as the gold veins. This method of trenching is even now used by the Chinese and Koreans to mine ores.

The pit method was to dig a series of wells or pits on the vein. Ore waste and water thus had to be hoisted. In the ruins of the old working at the Kanazawa gold mine, already mentioned, I found crater-like depressions along the strike of the veins. These indicate that the ancient miners worked the mine with pit methods. The Tsurushi silver mine, at Sado, was discovered in 1542, and opened in 1594. As mining was done by the pit method (tsurushi-bori), the name "Tsurushi" was given the mine thereafter. The Nobezawa silver mine, in the Kitamurayama district, Uzen, was opened in 1596 and soon became productive. A place in the region is named "Tsurushi." The name possibly had its origin in the fact that the mine was worked with the pit method. The method is still used by the Chinese and Koreans (Fig. 1).

Various references in literature are evidence that the pit method was used in very remote times. In "Nippon Reiiki," which was edited by Keikai in 810 A.D., an accident in a mine where magnetic sands were being worked, was described. This was in the Eda district, in Mimasaka, in 655 A.D. Nine miners were buried in caving sands, one only being saved by escaping into a neighboring pit. This would indicate that these sands were mined by the pit method.

In the Kōro copper mine, in the Naka district, Kii, cupriferous pyrite occurring in chlorite schists is mined. The slopes are sunk diagonally in a direction intermediate between the strike and dip of the veins, and branch in places. All of the ore and waste in this mine had to be carried on the miners' backs, out through the diagonal slope (Fig. 2). The method was widely used in the middle and western parts of Japan until recent times.

In "Konjakumonogatari," edited by Minamoto no Takakuni, 1073 A.D., an accident in a mercury mine, the Ise, was described. Three miners were caught in a slope by falling ground, two of them being killed. The third was confined in the dark bottom, but managed to burrow his way out.

"Tsushima Koginki," written by Ōe Masafusa, the governor of Kyūshu, in 1097 A.D., affords another record. The Tsushima silver mine was opened in 674 A.D. When miners were to go underground, they went in parties of three, one of them taking fire to guide them, another a vessel to hold the ore, and the third a hammer to attack the orebody.

Of the three methods described, the trench method was naturally the first to be devised, and next the pit method in conjunction with the former. But the need for transportation of ore and waste and draining water imposed limitations on their use. This led to the development of the diagonal-slope method, which probably was devised in Japan, as I could find no evidence that it was ever employed in Korea and China.

In the sixteenth century, new mining methods, introduced by the Spaniards and Portuguese, involved the driving of levels of small rectangular section 3x4 ft. or 4x5 ft. The trench method then soon disappeared, but the pit method was still used. The diagonal slope is still used in small mines and for connecting passages between levels or as drainageways to arrange hand pumps in cascade.

Ancient Process of Metallurgy in Japan[4]

In "Tsushima Koginki" I find the following description: "The ore is put on a high peak, where winds of any direction blow, and burned with fuel of pine wood for many days. Then the product (silver) is washed with water." The record is too meager to indicate the process used to reduce the silver.

The Tsushima silver mine was opened in 675 A.D., and in this mine sphalerite is mined today. The ore deposit, which is contiguous to sheets of quartz porphyry, was formed subsequent to the eruption of the latter. The ore consists mainly of galena, sphalerite, and pyrrhotite, with some chalcopyrite and pyrite. The principal minerals assay, in percentages, as follows:

	Silver	Gold	Lead	Zinc
Galena	0.2207	.....	76.10	.....
Sphalerite	0.0032	.....	.....	44.61
Pyrrhotite	0.0012	.....	.....	.....

The galena was probably rich in the upper part of the deposit, but decreased with depth. In ancient days, the mine was probably rich in galena, which carried considerable silver. Silver is really non-oxidizable, whereas lead and sulphur are easily oxidized by roasting. Therefore it is possible to get metallic silver by separation of lead and sulphur by use of plenty of fuel and time, and by ignoring the loss of silver caused by volatilization of the lead. Such defects as these would be negligible for the ancient Japanese.

According to Polybius (204-125 B.C.) and Pliny (23-73 A.D.), the Romans smelted argentiferous galena ore to get silver by oxidation. Therefore the description of "Tsushima Koginki" can be assumed to refer to the oxidation process of recovering silver.

Metallic lead was probably obtained by reduction

[4]Nishio, K.: "Ancient Smelting of Silver and Copper in Japan." J.M.A.J., April, 1921, No. 434, pp. 230-237.

with charcoal made from wood, when galena was smelted for silver.

The "Mabuki" process for smelting copper has long been used in Japan. This is an oxidation method, resembling the bessemer process on a small scale. Some hold that the process was invented in the latter part of the seventeenth century, and others that it came into use early in the sixteenth century. When I undertook to write "Mining in Japan, Past and Present," for the Japanese-English Exhibition, in London, in 1910, I was inclined to think that the "Mabuki" process had its origin in the distant past.

Copper has long been obtained from its ore in Japan by smelting. In 694 A.D. the mint for copper coin was erected; in 698 A.D., copper ores were discovered in Inaba and Suo, and in 708 A.D., native copper was discovered in Musashi, with which "Wadokaiho" coin was cast. At that time seven provinces—namely, Suo, Negato, Iyo, Chikuzen, Buzen, Hizen and Yamato—were listed as copper-producing areas, and their total production, supplied to the mint for copper coin, was recorded as 68,444 lb. per annum.

Though there was no literature of copper smelting in olden times, it is evident that there was wasteful use of fuel, time, and labor, as in silver smelting. The copper ore was roasted with an abundance of fuel for a long time. Up to 1264 A.D. the furnace was not used in Japan; the ore was roasted with fuel spread under it, and directly upon the ground, the sides of the heap being inclosed with stone and clay.

In the "Mabuki" process, the ore was first crushed to separate the waste; the prepared rich ore was then roasted with fuel to drive off the sulphur (roasting stage); next the roasted ore was melted by a strong blast, produced by a bellows, so as to separate part of the iron which combined with the flux to form slag. Thus a matte was produced. Then, by increasing the blast and charging more charcoal, the rest of the sulphur was driven off and the iron that remained formed slag ("dobu") with considerable copper, and at last metallic copper was produced in the bottom of the hearth ("Mabuki" stage).

In 1902, the copper mines in the southwestern half of Japan were employing the "Mabuki" process, oxidation smelting, and those in the northeastern half were conducting reduction smelting. The former was known as a copper producing region since early days, and the latter district contained mines developed since the latter part of the seventeenth century.

After the civil war of Onin, 1466, the country was in great disorder. Many of the people of the southwestern part of the country sailed to China to trade there or to attack its coasts as invaders. In Europe the Dark Ages were passing and learning was reviving. The utilization of the magnet, which was brought from China, was in large measure responsible for the development of navigation, resulting in the discovery of America and the circumnavigation of Africa, the occupation of India, and the erection of the base of operation on Goa by Portuguese, and their advancing to Kwang-Tung, China, in 1526.

With the world trending as it was, the mining industry in Japan could not avoid making some advance. As the copper ore produced in the southwestern part of the country was becoming lower in grade after long working, the primary oxidation process no longer furnished sufficient matte for continuous working. Early in the sixteenth century Doya Shinemen improved the process to meet this condition, which was called "Yamashita-buki" after the name of the village where his smelter was erected. In the improved process the operation was divided into two stages. The first stage stopped with making matte. After the matte was collected to the necessary amount to charge into the hearth, the operation of the second stage, matte smelting, was conducted as before described. At that time the charge for one hearth was 500 to 600 lb., requiring one person for the hearth and one for the bellows.

A little later Kamiya Jutei,[5] a merchant of Hakata, now Fukuoka, Kyushu, introduced from China the liquation process, which was earlier by about one hundred years than Sumitomo Jusai was taught it by a Portuguese at Sakai, Settsu. The Kamiya's liquation process was probably one which the Chinese had transmitted through the continental intercourse from Europe. At the same time Mitsuda Sukeyemon transmitted also the method of manufacturing cinnabar from China. These improvements were heralds, as it were, of the coming brilliant age of the Toyotomi and Tokugawa period.

Toyotomi Hideyoshi brought all Japan under his sway in 1585, and encouraged trade with foreign countries. Thus Japanese merchants sailed to Tacao (Formosa), Macao (Kwang-Tung, China), Luzon and Cagayan (Philippines), Binh-Thuan and Thuan-hoa (Anam), Cambodia, Patani, and Ligor (Siam), Dendang and Maracca (Malay Peninsula), Batavia (Java), Borneo, and so forth, where they built settlements. Before this, in 1543, Portuguese came to the Tane Island of Satsuma, and in 1549 Francisco Xavier, a Portuguese missionary, arrived at Kagoshima, Satsuma, and traveled through inland for about two years, spreading the knowledge of European science while he was making Catholic converts. Spaniards arrived at Hirato, Hizen, in 1583, and Hollanders came in 1600. Thus some knowledge of European civilization was spread throughout Japan.

Previous to this time in Japan gold was obtained only from stream beds and gravels, but after the sixteenth century the mining of gold in the hills began to be practiced.

In the latter part of the sixteenth century, Toyotomi Hideyoshi opened the Tada silver mine, in Settsu, and its abundant production was said to be the source of the prosperity of the period of Momoyama. Tokugawa Iyeyasu adopted the advice of Okubo Iwaminokami and opened the silver mines and gold placers in Izu, which were so productive that Iyeyasu invited P. Provincial, a Spanish missionary, to see the mines, that he might show him the wealth of the country. In 1601 the famous silver mine was discovered at Aikawa, Sado, which was afterward called the Sado silver mine, and the new methods of mining and metallurgy were applied in developing it. Concerning the development of the mine, it was said that Spanish missionaries helped considerably. Since then, the use of drifts and adits of rectangular cross-section, 3x4 ft. or 4x5 ft., was the practice throughout the country, supplanting the old methods of trenches and pits. In 1610, when Iyeyasu was to open commerce with Mexico at the request of Don Rodrigo de Vivero, governor of the Philippines, the latter proposed to send fifty miners to develop the mines in Japan. The plan fell through, as Rodrigo proposed to give one-half of the profit to the miners and to divide the remainder between the King of Spain and Iyeyasu, so that the former would receive $1,000,000 per annum. In 1613,

[5]Nishio, K.: "Transmission of Liquation Process," J.M.A.J., Oct., 1922, No. 452, pp. 682-685.

Date Masamune, a powerful Daimyo of Sendai, sent his subject, Hasekura Rokuemon, to the courts of Spain and the Pope of Rome, to study trade conditions and to request the dispatch of missionaries, and it was also considered that the engagement of mining engineers was no small part of his objective.

In draining the Sado mine, the old-fashioned well buckets were used. In 1618, the Spondoi (a simple style of piston pump) was tried successfully. In 1637, an Egyptian screw was designed by Soho, a hydraulic engineer of Osaka, and in 1782 a fire pump (Spuite brand) was brought from Holland, and it was also successfully applied. Usually in mines in Japan the custom in pumping was to use the piston pump, but in the Sasu silver mine (formerly the Tsushima mine) a treadwheel was used in 1730.

As it was hard work to cope with gushing water underground, in the Ikuno silver mine, the Romabu adit was driven in 1608, on which work criminals were employed, and the Takeharano adit was driven in 1638. In the Sado mine, driving the Mizukane-Zawa adit 2,880 ft. long was begun in 1629, and was completed after ten years' work. Afterward the Ogiri adit, 948 ft. long, was begun in 1647 and finished twelve years later. The Minamizawa adit, which was the latest to be driven and is in use today, was begun in 1691. In the course of this work two intermediate shafts were sunk and driving was begun on six faces with hammers and chisels, the advance being 3,014 ft. in six years. In the Iwami silver mine the Shinkiriyama adit was driven in 1715, likewise an adit in the Handa silver mine in 1740. To provide ventilation, in the Ogiri adit and the Shinkiriyama adit, accompanying "flue tunnels" were driven, that for the former being 1,080 ft. long and on its right side and for the latter underneath. Ventilation in driving the Minamizawa adit was accomplished by means of brattices.

Ore dressing and the metallurgy of silver and gold made progress from the early part of the seventeenth century. The cobbing of ores in the Sado mine was similar to that practiced in Cornish tin mines in England. The dolly tubs used there were exactly like those of today, as were some other features. The separation of silver in gold bullion by chloridizing roasting, cupelation, and liquation was practiced from the latter part of the sixteenth century. It is curious that the amalgamation process was not brought by the Spaniards to Japan, for the reason that in Japan the amalgamation of gold and silver for gilding had long been known. In the latter part of the sixteenth century the Spaniards were profitably practising the process on the silver ores in Mexico. After long consideration I am inclined to believe that amalgamation was introduced with other processes by the Spaniards at that time, but that it did not develop sufficiently to leave a record. Only the name of the Mizukane-zawa (Mercury Creek) in the Sado mine remains as evidence where there is no relation to mercury.

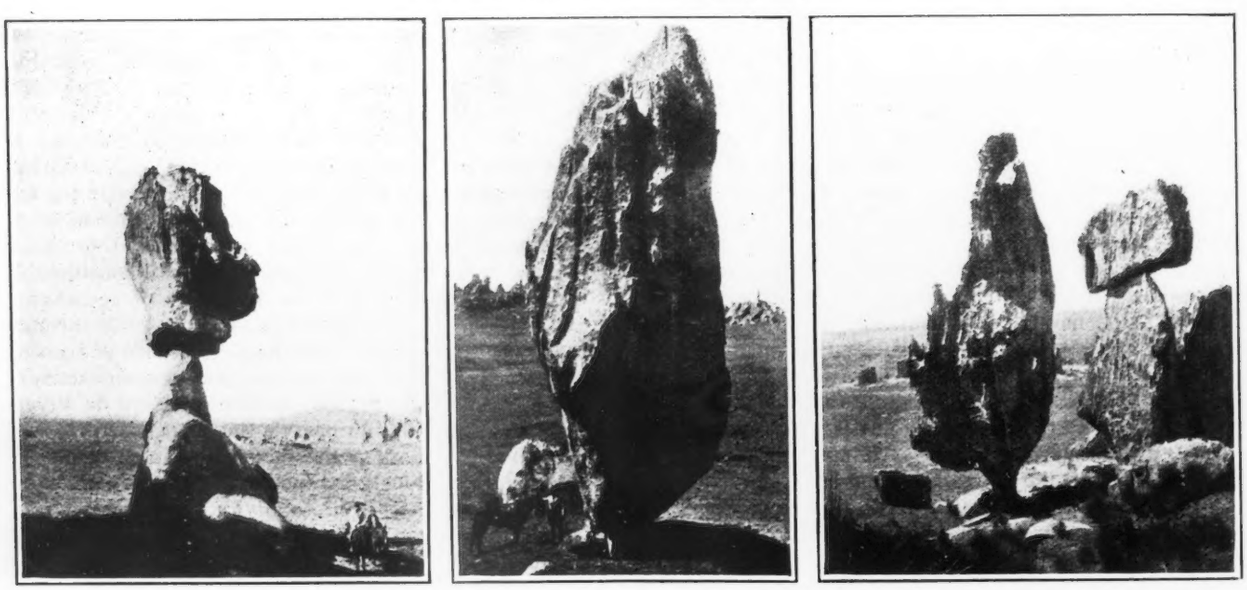
The melting and casting of placer gold and fine grains of gold and silver from the plane table were practiced. In the latter part of the sixteenth century, placer gold of Nishimikawa and magnetic sand in the weathered granite in Chugoku were concentrated in channels as in sluices, the water being brought from a great distance.

In copper smelting not only the old method, the Mabuki oxidation process, was improved as the "Yamashita-Buki" process, as before described, but also the reduction process was introduced in the Ani copper mine, in Ugo. As the process worked successfully, it was soon adopted in the copper mines of the northeastern part of the country. (I believe that the method was introduced at the Ashio copper mine in 1610.)

The record indicates that the development of the mining industry in Japan was influenced by Koreans and Chinese until 1,500 A.D. After that time it was influenced by the modern European technology through the Spaniards and the Portuguese, and, lastly, the Hollanders. Since the Restoration, in 1868, the mining industry of Japan has made great advance through the adoption of modern civilization and practices.

[9]Nishio, K.: "Pumping in the Sado Mine," J.M.A.J., Nov., 1922, No. 453, pp. 745-749.

In the Rock Forest of Junin, Peru



Left. The "Old Inca." Center. Another remnant estimated to be 50 ft. high. Right. The "Cock and Hen"

Manganese Mining in India

Occurrence of the Ores and the Method of Extraction

By E. W. T. Slater
Hassan, Mysore State, India

BEFORE the war manganese ore came chiefly from Russia and India, but in recent years other sources have been discovered, in Brazil, the Gold Coast of Africa, and a few other places. Despite such competition, however, there is little doubt that the manganese industry in India at least will continue to develop as the demand for the ore increases. The Indian fields have proved useful, and reports show that prospects for the future are good. The Indian ore, on account of its hard lump form, is more suitable for blast furnaces than the more friable ores obtained from the Caucasus. It is also possible, owing to the better selection, to export a more uniform quality than that which characterizes the Russian shipments.

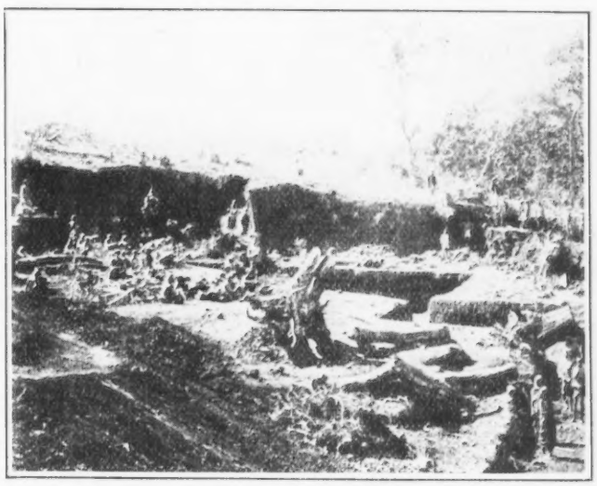
The ore consists mainly of psilomelane with an important amount of braunite. The grade of ore varies in different districts in India, but on the whole is considered high. The ores of the Vizagapatam district are mainly psilomelane with small amounts of pyrolusite and braunite; the typical ores of the central provinces consist of mixtures of braunites and psilomelane; the ores in Mysore are usually associated with banded ferruginous quartzites. The ores from the central provinces are considered of the highest grade; those from Vizagapatam and Mysore belong mainly to the second and third grades. The first-grade ores have a high manganese content, usually from 49 to 54 per cent, and a moderately high iron, from 4 to 8 per cent. The silica varies from 6 to 9 per cent and the phosphorus runs about 0.07 to 0.14 per cent. The second and third grades are characterized by high iron and phosphorus content and comparatively low silica.

Though a good deal of prospecting has been done, no new fields of commercial size have been discovered in other parts of India, though it is yet too early to say what a more complete survey will disclose. At present practically all the ore mined is shipped to Europe and America for conversion, only a few thousand tons being used in India, and this chiefly as a desulphurizer in iron and steel furnaces. With the development of the iron and steel industry in India doubtless a larger demand will be made on the supplies, but for many years to come the country will need to seek its markets in the west.

Unfortunately, the high percentage of phosphorus in Indian ore and coke makes it less satisfactory for Indian use than that from other parts of the world; but with the improvements in the iron trade the necessary adjustments would probably be easily made.

Some years ago the manufacture of ferromanganese was begun in India at Jamshedpur and an alloy running 70 per cent manganese, 0.55 per cent phosphorus, and 2 to 3 per cent silicon was made. The output from one furnace reaches about eighty tons a day. Ferromanganese is also made by the Bengal Iron Steel Co., the product having a guaranteed minimum of 74 per cent manganese and a maximum of 0.55 per cent phosphorus. It is believed that, with a careful selection of the Indian ores, some real advance may be made, though new methods will have to be adopted in the blast furnace, it has been pointed out, if India is ever to become prominent as a maker of ferromanganese.

In recent years the manganese deposits in Mysore State have been extensively worked, principally by the Workington Steel & Iron Co. Prospectors staked claims and some work was done in several other districts, but for the most part it has not been successful. There are deposits in the Kadur, Chitaldrug, and Tumkur districts as well, but conditions do not seem favorable to active operations. In 1908 the company referred to took over the area in which it is working, and efficient and careful development has been realized. The work has steadily progressed and large quantities of ore have been sent to England. From the beginning operations have been under the control of one manager. The town of Shimoga was selected as headquarters, as it was on the railway and afforded good facilities for shipping. In this town a large shop for repairing the engines was erected; land was purchased near the railway for storing the ore: and provision was made for education of the employees who might be brought from other districts. A well-equipped dispensary and a laboratory for testing the ore were also built.



Typical view in the mining areas of Kumsi and Shankargudda

The ore is collected and stored in sheds near the railway. In supplying the market the company must be able to state definitely the amount of manganese in the ore, and as this varies considerably, a classification is essential. The grade of the Shimoga ore is high and the ore brings a good price at home.

The mining areas are known as Kumsi and Shankargudda. The former is about 3½ miles north of the small village of Kumsi. The ore is found *in situ* on the northern slopes of a subsidiary rise which is practically parallel to the higher and main hills of the locality. The geology of this area is rather obscure, owing to the heavy undergrowth and subsoil. But from the indications observable it appears that ferruginous quartzites and dolomitic limestones were the main rocks, with minor masses of quartz and quartzite rocks. The general strike of the ore is east of north. The ore occurs in a series of parallel bands or lenses covering an area 2,000 and 3,000 ft. long and about 450 ft. wide. The ground between lenses is almost barren and consists of residual clays and ferruginous soils with isolated boulders of manganese scattered through it. The ore lenses themselves are, in the main, made up of a ferruginous earth mixed with a black manganese-impregnated earth in which the ore has formed. First, wad has formed

and, later, psilomelane. Toward the eastern end of the property a large quantity of pyrolusite, of both hard and soft varieties, was excavated and shipped to England. The system of mining resembles the underground long-wall method, with this difference: no overhead roofing or galley work is necessary. There is a series of low wall terraces which are cut into the ore lenses which run the length of the hill. The ore is trammed

Branch railroad to Shankargudda manganese mine. The route lies through dense jungle

by hand in cars over tracks, 2 ft. in gage, to the inclines, or on the lower workings direct to the main line cars. The inclines operate by gravity, a loader carrier pulling up an empty one. The mine is linked up with the depot at Shimoga, a distance of 28 miles, by means of a well-built 2-ft. gage railway. The average gradient of this line is 1.25 per cent, and is almost entirely in favor of the load. The tramway has been extensively used by the Mysore Government to bring down large consignments of timber from its forests. The company has made it possible for the government to open country that it could not otherwise easily have developed.

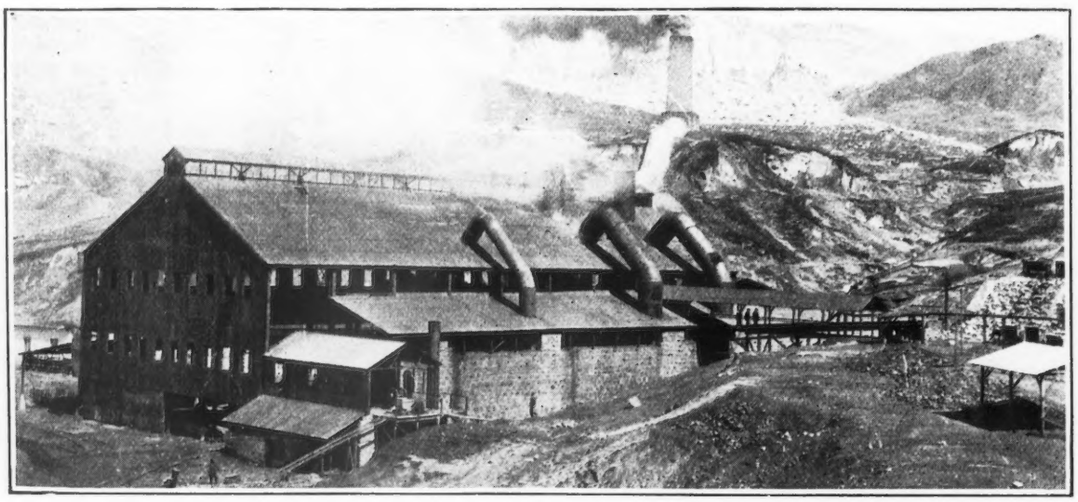
The second large managanese-bearing area is that at Shankargudda, where there is another large deposit. This lies about two miles south of the Shankargudda, a high peak. The ore-bearing ground runs in about the same direction as that at Kumsi and the formation is similar. The property is connected with Shimoga by means of a branch line also of 2-ft. gage. This line was completed after a careful survey, and many difficulties had to be overcome. The method of mining is the same as at the Kumsi mine. Inclines are used to get the ore down to the tramline.

All the ore, both from the Kumsi and Shankargudda properties, is graded at the central depot at Shimoga, after which it is shipped to England via Marmagoa or Madras. The tonnage shipped from these mines runs into hundreds of thousands, most of which has been

Along the railway to Shankargudda mine

sent direct to the extensive steel works belonging to the company, which is one of the largest in the world. The operation of these mines has brought a large number of people to the district, and the Government of Mysore ought not to overlook this fact in its relations with such mining companies in the state. The amount of money paid in wages is a great economic asset to the district.

A Reduction Works in Peru



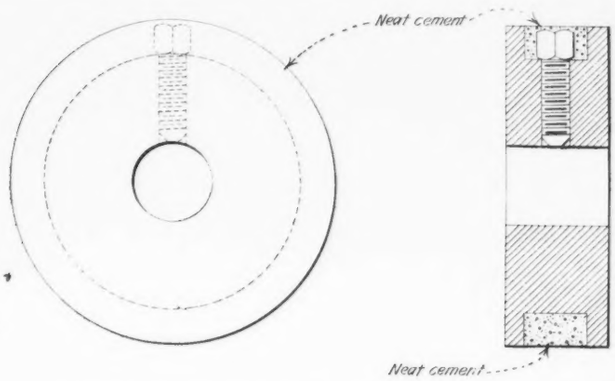
Copper smelter of the Huaron Mining Co. (French) at San Jose, 30 miles from Mina Ragra

Useful Operating Ideas

Safeguarding Shaft Collars and Flanges

By Roy H. Poston

An excellent method for safeguarding shaft collars and exposed flanges is shown in the accompanying illustration. The space between the flanges of the collars is filled with neat cement. The cement is mixed with water to the consistency of putty and the mixture



Cement can be used as shown for safeguarding flanges and collars

is applied, rounding off the top surface. A thin sheet steel cylinder can be placed over the setscrew and held temporarily by small wooden wedges until the cement hardens. By adding ordinary baking soda in small amount the time for setting can be appreciably shortened.

Making Short Nipples

By Charles Labbe

When a short nipple is unavailable, a simple method of making one by the use of the ordinary pipe dies is as follows: Take a piece of pipe of convenient length and thread one end. Fasten the other end in the pipe vice and slip the guide of the die upon the pipe. Then screw a coupling on the pipe and into this the short end of the pipe which is to be made into the nipple (one end of the pipe is threaded beforehand). The dies are adjusted, the guide is fastened and the thread cut. When the nipple is threaded, the guide is loosened and the die removed.

The work of unscrewing the nipple is accomplished as follows: A discarded fitting is sawed diametrically the length of the threads and case hardened. A separate fitting is provided in this way for each size. When needed it is screwed upon the projecting end of the nipple and the pipe wrench used to unscrew the nipple from the coupling. As an extra precaution a punch can be lightly driven into the nipple to prevent squeezing it out of shape.

Care and Use of Rock Drills

In former times, according to E. R. Borcherdt and H. D. Sultzer in the *Anode*, a common remark among miners when referring to a machine that was operating poorly was, "Send her to the repair man. He will give it a shot of oil and send it back." In the past a large number of machines have been sent to the repair man when a lack of oil was the only difficulty. In a check-up at one mine, during which 742 machines were sent to the shop for repairs, 115 were found to be seized with rust and had to be oiled and cleaned; 200 were found to be in first-class condition, and the remainder needed repairs of various kinds. There is perhaps no need to add that there was little excuse for this waste of time and energy when oil in the instances noted could have been obtained easily.

When the repair man receives a machine in bad order he must put it through the following tests and repair operations before sending it back to the mine: First, the machine is connected to the air line and run to locate the principal trouble. Then the side rods are loosened and the parts inspected. The water tube is tried with water, and if plugged a new water tube is fitted into place. Next, the water back is tried with water to determine whether the connections are all water-tight. This is done by placing the thumb over the end of the tube, thus closing it and causing leakage at other points if joints are not tight. If leaks are found, the parts affected are tightened or new parts used before it is replaced in the machine.

The next step is the cleaning, with kerosene oil and an air jet, of all parts of the machine. The piston is then placed in the cylinder and tested for wear with the aid of a tool called a feeler gage. If the piston shows a wear of more than five to six-thousandths of an inch, it is set aside and another tried until one is found to fit. It may be found that the cylinder has been worn, in which case a new part is provided and the worn cylinder set aside to be reground for an oversize piston.

After fitting the cylinder and piston, the clearance between the anvil block and cylinder washer is tested by the thickness gage and the clearance adjusted so that it will not exceed five-thousandths of an inch. A drill is then inserted to determine the amount of wear. This is not permitted to exceed $\frac{1}{4}$ in.; at the same time it is noted whether the center line of the chuck is a continuation of the center line of the machine. Wear in the chuck which permits more than $\frac{1}{8}$-in. clearance of the steel will make it necessary for the chuck to be swaged down to the proper size, or, if necessary, the face which fits against the cylinder must be refaced.

The back head is next opened and any rock which may have become plugged against the screen is removed; the throttle lever is tightened, the screen cleaned and replaced, and the throttle ratchet reset. If a leak was found in the throttle when the air was first turned onto the machine, a new throttle is provided, or if the

back head is worn so as to destroy the alignment of the parts, a new back head is used. The dowel pins are replaced if broken and the parts fitted together.

The feed piston is then removed from the feed cylinder and the condition of the cup leathers noted. If necessary, new ones are placed on the piston and tested by suction to see whether they fit tight. It may be necessary to place a new feed point on the piston or grind the old one to a new point.

All the parts are now placed together in their proper order and drawn up snug by the side rods. These rods are not drawn tight enough to cause them to break or to take all of the compression out of the front head springs.

The reassembled machine is then tried out on a strand and particular attention paid to discover any leakage at the junction of the different sections. When such leaks are found an effort is made to correct them by further tightening on the side rods. If this is ineffective, the faces must be reground.

The foregoing procedure is common for all hand-rotated stopers. With a few additions the same serious consideration is given when overhauling the drifters and self-rotating wet stopers.

Drifters are connected to the air hose and operated, so as to locate any exceptional trouble. At the time the feed screw and feed nut are examined for wear and if necessary are replaced with new parts. Should too much play be noticed between the shell and the machine guides, a shim is inserted and the wear taken up. This fit should permit of a free movement of the machine when cranked, but should not be excessive. Finally, the feed screw support is tightened in place and the crank handle tightened sufficiently to take up any wear in the crosshead. The shell bolts are always kept tight.

The side rods are removed and the springs examined; if broken, new ones are supplied. The back head is removed and tested with water for leaks. The leakage of only a few drops a minute is not permitted. This is because it has been determined that only a few drops of water, constantly dripping, will wash out the lubrication as fast as it enters the machine and result in rapid wear and loss of rotation. Also, a few drops on the feed screw will do the same thing. Leakage will occur in time in any machine, but it has been found that most of the leakage results from changing water tubes underground. The average miner has not the necessary tools to make a proper change and very frequently will lose the copper gasket necessary to form a seat under the gland cap.

The front head is removed and attention given to the cylinder. The limit of wear between the piston and cylinder walls is between five- and six-thousandths of an inch, depending upon the steel used. The front cylinder washer has the same allowable limits. New parts are used, depending upon which one has worn the most. The valve is removed, examined for wear or breakage, and replaced. The oiler is opened and examined for dirt, and the opening for the passage of oil is cleared, if necessary. The piston is removed and the wear on the front and rear flutes noted. Should the wear make it necessary, a new piston is used to replace the old one and is tested for proper fit. The rifle bar which works against the flutes in the rear end of the piston is examined, and, if worn, replaced with a new rifle bar. The pawls are examined for wear; also the pawl plungers and ratchet ring teeth; finally, the springs are tested for strength. Then the springs, plungers, pawls, rifle bar, and ratchet ring are reassembled and the back cylinder washer is placed over them.

The front head is next inspected, and should the bronze retaining bushing be worn it is replaced with a new one. When square steel is used an anvil block is necessary, and frequent examination of this part is made to insure against a chipped or cupped face. Chipped anvil blocks result from the steel sharpener getting the shank too hard, and once it is chipped it may damage every steel put into the chuck. The anvil block is reconditioned by squaring up the face on an emery wheel, or, if it is badly damaged, a new part is used. When the chuck is badly worn, a new one is placed in the front head.

When using round steel no anvil block is necessary. A limit gage is used to determine when the back bushing is worn and also when the lugs on the shanks have been driven into the front bushing sufficient to short-stroke the piston. To protect the front head against breakage, chuck keys of different sizes are on hand to take up any amount of wear. For the square steel, iron washers of the desired thickness are used. The different sections are reassembled in their respective order, drawn up snug with side rods, and tested with air. At this time the tee filter is cleaned of all rock or pieces of rubber gasket that may have become lodged against the screen. The hose spud is changed if found to be worn, and the machine is again ready to be sent underground.

The same careful attention is given a self-rotating stoper, jackhammer, or any other rock drill. Should any unusual trouble occur, a special effort is made to locate the trouble and if possible to remedy it. To complement and make effective all the care that has been given to the machines in the shop, it is expected that proper attention will be given them underground. Placing the machines on and taking them off the cages; getting them into the stopes, raises or drifts; carrying them into the working face, or back from the blast, and finally returning them to the shop all call for careful, sure handling, so that dents or breakage to the machines may not result.

More co-operation between the miners and the shops would result in great economy of time. A note sent to the shop, with a machine that is not working properly, calling attention to what is thought to be wrong, will be a great help to the machinist. Especially will this be true if the trouble is one out of the ordinary run.

Sparks coming from the chuck of the machine are evidences of breakage to the steel or anvil block. Being sure that the steel has a good shank and goes readily into the chuck will do away in a large measure with steel becoming riveted or stuck in the chuck. The use of oil at regular intervals will do wonders in speeding up the drilling. The robbing of parts from one machine and placing them on another is a waste of time. Usually, the change made does not remedy the trouble and a new machine must eventually be obtained with which to finish the round. When indications of trouble to the machine begin to appear, it is well to take steps toward getting another. It may be only trivial, but both the miner and the company will profit by the forethought.

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

Continuous Vacuum Filters in Cyaniding

THE EDITOR:

Sir—I have read with considerable interest the comments made by Henry Hanson and L. B. Eames in your issue of Nov. 1 in reference to my article on "Continuous Vacuum Filters in Cyaniding," which appeared in your issue of Oct. 11, 1924. I am pleased to note that my article has started discussion in your columns.

I note Mr. Hanson does not agree with my conclusion that "continuous vacuum filters operating in series are the most efficient devices for separating the pregnant solution from the solids after agitation." Mr. Hanson states "that filters in series are used at one plant is no criterion."

The above-quoted conclusion was not based on the fact that this process was used at one plant. When I formed this opinion in October, 1921, there were, to my knowledge, no plants using this process. The fact that a displacement wash of from 75 to 87 per cent could be obtained on continuous vacuum filters in one filtration was the deciding factor, and the other points enumerated in my article were contributing factors. By taking the pulp at a dilution ratio of 1 to 1 direct from the agitators, filtering on the first filter, discharging the cake after spray-washing at 25 per cent moisture, repulping and diluting back to a ratio of 1 to 1, and repeating the process, it was obvious that the maximum saving of dissolved values could be effected with a minimum of capital expenditure. Determining the capacity and washing efficiency of vacuum filters on any particular ore by test, it is a simple matter to predict the results to be obtained by the method outlined for flow sheet No. 5. Later tests and results from large-scale operations have proved this to be correct, but some of these later tests have shown that it is possible to get as high as 96.1 per cent displacement washes. These latter results could probably not be maintained continuously; therefore in my article I used the figure 90 per cent as being average.

Prior to 1921 it was the common belief among metallurgists that continuous vacuum filters were efficient for dewatering purposes, but one could not expect to get good washing efficiency from this type of filter. No doubt this is true on some ores. Porcupine slimes are particularly free-filtering, and the washing efficiencies obtained on continuous vacuum filters are illustrated in the following table. These figures are based on results obtained in the field. I am not at liberty to give the names of the plants from which the particular results were obtained. Interested parties can write to the various companies using vacuum filters, and no doubt the desired information will be forthcoming.

Test No.	1	2	3	4	5	6
Assay value, in dollars, of solution in filter feed	4.21	4.50	4.53	3.44	3.24	7.01
Assay value, in dollars, of solution in filter cake after wash	0.161	0.23	0.278	0.74	0.42	0.74
Displacement efficiency of spray wash, per cent	96.1	94.9	93.86	78.4	87.0	89.4

As I pointed out in the article in question, both capacity and washing efficiency on continuous vacuum filters will vary considerably on different ores, and only tests will give the necessary data.

Mr. Hanson states that only a certain amount of solution can be drawn through the cake on drum filters and that any excess added runs down the side of the filter. This is obvious. The wash should be properly sprayed on vacuum filters, whether of the drum or disk type. High-pressure sprays should be used to atomize the spray thoroughly, and the number of sprays and their arrangement should be adjusted in the field to suit particular conditions. Even though there is a small amount of solution which runs off the cake, the factor controlling the degree of displacement is the volume drawn through the cake. If the cake is covered with spray wash during the washing period, the washing efficiency will be the same whether drum or disk type filters are used, provided the conditions of operation are the same. The only effect any solution which runs off the cake has on the operation is that dilution of the pulp in the filter tank has a slightly adverse effect on capacity. This is taken care of on the American filter by drip collectors placed between the disks to catch the run-off and prevent it from getting into the filter tank.

Mr. Hanson points out that "the theoretical formula traced on flow sheet 5 did not show as complete displacement as was indicated by flow sheets 2 and 3." In other words, the total theoretical losses indicated by flow sheets 2 and 3 were $0.85767 and $0.7808 respectively per 100 tons of dry solids treated. Flow sheet 5 showed $1.1626. Difference in favor of 2 and 3 would be $0.30493 and $0.3818 respectively. The difference in favor of 3 would be $0.003818 per ton of dry solids. I might say that this slight difference could be taken care of by a ridiculously slight increase in the precipitation ratio on 5.

With reference to my assumption that, theoretically, no extraction takes place in the thickeners after agitation. This of course is not strictly true and was done to simplify the figures. I wish to state here that the mills making the highest percentage of extraction of undissolved values in the decantation tanks usually send the most gold to waste. To design or operate a mill with the object in view of making a considerable extraction in the decantation tanks is an unsound policy. The high extraction is due usually to insufficient comminution of the ore and gold or insufficient agitation. Sometimes it is a combination of the two. Any dissolution which takes place in the decantation tanks must be taken care of by an increased precipitation ratio. If the ultimate dissolution has not taken place before the pulp has left the agitators, the double

filtration scheme is certainly as efficient a means of dissolution as the decantation tanks. The pulp is formed on the first filter, air is drawn through the cake, freshly precipitated barren solution is sprayed on the cake, and the cake is repulped with barren solution and re-agitated before it is sent to the second filter. I have yet to see a gold ore in northern Ontario which failed to respond to this treatment.

Hanson's statement that a density in the agitators of 1 to 1 "tends to retard the dissolution of precious metals" is not founded on fact except in cases where highly refractory ores are being treated. Numerous tests which I have conducted and which have been made by others in this district have proved that nothing is gained by diluting the pulp in the agitators above 1 to 1. There are several decided disadvantages in so doing. First, greater volume of agitators is required to give the same time of contact; second, the granular particles have a tendency to settle rapidly in dilute pulp, causing mechanical troubles. To prevent this a part of the pulp from the agitator air lifts must be cut out and by-passed to the succeeding agitators or tanks. This hastens the material through the agitators, which really requires the longest treatment.

Finally, Hanson states that the "double filter system is not so elastic as, nor does it offer the protection to fluctuating mill feeds that is given by, a system embracing both counter-current decantation and filtration." Whether double filtration or counter-current decantation is used, the degree of elasticity, or the facility for handling ores of changing value, is determined by the range over which the precipitation ratio may be varied in plants where milling is done in cyanide solution.

Assuming that plants are designed in accordance with flow sheets 1 and 5, and neither has a large excess capacity over actual requirements, it will be seen that the amount of excess solution overflowing the primary thickener, over and above the amount required for precipitation under normal conditions, represents the extent to which the precipitation ratio may be varied, unless solution is drawn from several tanks in the decantation series. In flow sheets 1, 2, 3, and 4 this amounts to 80 tons for each 100 tons of dry solids milled. In flow sheet 5 it amounts to 166 tons of solution per 100 tons of dry solids milled. There is more than twice the volume of solution available for precipitation in 5 than there is in any of the others; therefore the facts prove the exact reverse of Hanson's statement.

In reference to Mr. Eames' comments, it must be pointed out that, during his time at the Hollinger, the slimes from the classifiers at a dilution of approximately 4.5 to 1 were passed to fifteen 13-in. diameter thickeners. The discharge from these thickeners was restricted sufficiently so as to maintain a muddy overflow and force the fine colloidal slime over the top. These slimes were passed to eight 30-in. diameter thickeners, in parallel, thickened to approximately 1 to 1, agitated in Dorr agitators, and then filtered on Moore filters. This gave the filters the fine colloidal slimes to handle, and the remainder, or the underflow from the 13-in. thickeners, passed to the decantation plant. Naturally, with practically a clean granular product, the results quoted by Mr. Eames were possible. Also, the tonnage handled per unit of 40-in. diameter tanks was 225 per twenty-four hours. After trays were installed in these thickeners approximately 380 tons per unit was handled; after the filters were installed on the end it was possible to get this capacity up to 535 tons per unit.

Any decantation plant having a large settling area per ton of solids, and able to maintain the discharge from each thickener at 40 per cent moisture or lower, and if sufficient solution is precipitated, will give excellent results. I have knowledge of one test conducted in this district several years ago, in which experimentation slimes were permitted to settle for seven days, and at the end of this time the thickened pulp still contained 48 per cent moisture. Under these circumstances the figures quoted by Eames would be far from materializing.

In the matter of losses due to absorption, these will be in direct proportion to the value of the solution at the beginning of cyanidation; therefore it is necessary to keep the solution values down by precipitating a large volume of solution. This is particularly true of plants in which milling is done in cyanide solution. A better means of reducing the so-called undissolved losses would be to impoverish the ore prior to cyanidation by grinding in water; then amalgamating or concentrating, depending on the ore characteristics; then dewater and cyanide the tailings. If concentration is employed, the concentrates should be ground very fine and cyanided separately.

Interested parties desiring further information and figures from companies operating continuous vacuum filters should address their inquiries to the following: Hollinger Consolidated Gold Mines, Ltd., Timmins, Ont.; Teck-Hughes Gold Mines, Ltd., Kirkland Lake, Ont.; Wright-Hargreaves Mines, Ltd., Kirkland Lake, Ont.; and Argonaut Gold, Ltd., Dane, Ont.

Timmins, Ont. B. D. KELLY.

Early Dredges in British Columbia

THE EDITOR:

Sir—In an article in your edition of Dec. 6 in regard to Kafue dredge on Antler Creek, in the Cariboo district of British Columbia, the statement is made that "this is the first dredge to be tried in British Columbia placers." I do not know the source of this statement, but, from personal knowledge, I would say that in the middle 80's a party from western New York started for the Fraser River above Soda Creek, taking with them a 6-in. centrifugal pump, an engine and boiler, and an outfit of small tools. They built a hull and floated this "dredge" and worked during the summer months. Their efforts were not successful financially, but, on their return, they showed colors of gold that they had won from the river bed with this inefficient device. They also told of other "dredge" work that was being done on the Fraser while they were there, some of which had been started before their arrival on the ground.

In 1895, while with the Bucyrus Co. at South Milwaukee, I saw some dredge machinery, for gold dredging, shipped to a party named Hogue, at Edmonton; later Drolet et Cie. built some dredges for placer working on the north Saskatchewan. The Cobledick dredge, which was worked at Lytton, B. C., for some years, was of the chain bucket type. The machinery was built in England. I saw its remains in 1902. Prior to this date, F. Satchell Clarke built a similar machine, called the Edwards Creek & North Thompson River Gold Dredging Co.'s dredge, on Edwards Creek, B. C. In 1902 I crossed in a stage from Hat Creek, B. C., to Lil-

loet and at that time saw workmen starting to build a dredge hull in the Fraser River across from Lilloet. This machine, known as the Iowa-Lilloet, ran for some years. I have photos of it taken in 1906. In the late 80's Thomas Drummond took a small dredge down the Quesnelle River for a distance of ten miles from the mouth of the Beaver. He prospected bars and river bed with this machine. On a trip up the Fraser in the Steamer "Josephine," from Soda Creek to Quesnelle, in 1902, I saw several abandoned dredges of the dipper and of the suction type along the banks between these two points.

Of course, these dredges were not of the modern California type and were crudely built and somewhat unsuited for the purpose intended, but they were certainly built and operated to some extent, hence the Kafue dredge is surely not the "first dredge to be tried in British Columbia placers." GEORGE L. HOLMES.

San Francisco, Calif.

The Proper Treatment of Coarse Gold

THE EDITOR:

Sir—I have read with keen interest the editorial comments which appeared in your valuable paper under the caption "Fine Grinding Gold in the All-Slime Process," on the paper recently published by The Institution of Mining and Metallurgy, written by K. L. Graham and F. Wartenweiler. Varied metallurgical decisions have been made by different technicians in the field when dealing with coarse gold contained in ores which have closely similar petrographic and physical characteristics. I have in mind four mills, all of which are in the same district, and all of which are concerned with the extraction of both fine and coarse gold from a gangue composed of approximately 90 per cent schist with 10 per cent of quartz. The largest of these mills relies upon gravity concentration to effect the recovery of large particles of gold, which, it is thought, would remain undissolved during the subsequent treatment and cause a serious loss. The mill which is next in point of size depends upon amalgamation to bring about the same result. The two remaining mills have strictly "all-sliming" flow sheets and make no provision whatever for the large particles of metallics in their feed. The extractions in all four mills are similar.

In the "all-sliming" plants, not only does the mill feed contain coarse gold, as evidenced by collections of such material in the launders and by examination of ore in place in some of the richer stopes, but the practice has been to feed "high-grade," which contained considerable amounts of visible gold, direct to the primary grinders as a means of economically effecting the recovery of the contained values. Such evidence leads me to reflect whether the statement, made in the article quoted above, that "no advantage can be taken by gravitational classification and return to the mills," is strictly correct in all cases. It seems probable that such coarse gold continues to circulate in the grinding circuits, by virtue of a density which is considerably greater than that of any of the gangue minerals, until the settling rate of the gold particles is such as to permit them to pass out of the classifier. It is not meant to imply that the "mesh" of the gold particles is necessarily reduced, for it is probable that with a metal of such ductility they are merely flattened. Such a change brings about a reduction in the settling rate in the bath of the classifier and at the same time increases the rate of passing into solution during the subsequent agitation treatment. When grinding to a fineness of the order of 93 per cent through 200, I have observed that the fractional percentage remaining on a 100-mesh screen contains assay values lower than the mill head. Obviously, this would not be true were particles of coarse gold only partly dissolved. Whether the degree of subdivision is reached at 260 mesh, at which specific gravity plays a part so diminished that differences may be neglected, and settling rates will be independent of this factor, is another questionable point. The answer would seem to be that this is not so, and that, as a consequence, the average size of the gold particle overflowing the classifier is less than the average size of the gangue particle.

Another point upon which more light should be thrown has to do with the statement that "the residue from minus 260 plus 300 (printed as 200 but assumed to be a typographical error) mesh Robinson gold was 1.66 dwt. after eight hours' agitation and 1.64 dwt. after sixteen hours' agitation, an increase of only 0.4 per cent," whereas in the case of a sand product, as is quoted later, in which the gold is minus 260 mesh, the extraction was perfect after four days. If the rate of passing into solution is assumed to be constant, the gold would not be carried into solution even if the agitation of the slime were prolonged for four days, in so complete a manner as with sand. Is the fact that the ratio of surface to volume increases as the diameter of a gold particle decreases sufficient to account for the discrepancy, or is there some obscure behavior by the slime which hinders the attack of the cyanide on the gold? It is unfortunate that the agitation experiments were all of such short duration.

The subject is one of extreme interest, not to say of considerable metallurgical importance, and I hope to see further pertinent discussion.

Parral, Chih., Mexico. ALFRED R. SMITH.

Fluorspar and the Aluminum Company

THE EDITOR:

Sir—Your article in the Nov. 29 issue of *Mining Journal-Press*, on the recent purchase of additional fluorspar properties by the interests of the Aluminum Company of America, shows in its apparent compilation quite a lack of knowledge of the facts known to those who keep well informed on the fluorspar industry.

The Kentucky Fluor Spar Co. is an old organization, its charter dating back more than twenty years, and generally it held first place as a Kentucky producer of fluorspar. During the World War, the company underwent reorganization, consolidated with some other companies and otherwise greatly increased its strength and position as a Kentucky producer.

But more than a year ago the Lafayette Fluorspar Co., which was created as a subsidiary of the United States Steel Corporation, bought several of the best properties of the Kentucky company. After this the Kentucky Minerals Holding Co. was organized by stockholders of the Kentucky Fluor Spar Co. and the Fairview Fluorspar & Lead Co., with the control vested in the latter interest, to lease and operate the few remaining properties left to the Kentucky Fluor Spar Co.

There has been no manifestation of outbidding by the Franklin Fluorspar Co., a subsidiary of the Aluminum Company of America, against "the Steel inter-

ests," as your article states, but merely the acquisition by the Aluminum interests of the properties of the old Kentucky Fluor Spar Co. that were left after the Lafayette transaction, and the acquisition of the properties of the Fairview Fluorspar & Lead Co.

In listing the properties as acquired by the Aluminum Company interests (Franklin Fluorspar Co.), your article is wrong and misleading in publishing a photograph of the Tabb or Hoosier mill as though the Tabb or Hoosier property was one that was concerned in the recently recorded transactions. As a fact the latter property belongs to the Lafayette Fluorspar Co., as also do several of the properties that you have listed as included in the purchase made by the Aluminum interests.

The names of the properties of the old Kentucky Fluor Spar Co. that were involved in the recent transaction with the Franklin Fluorspar Co. are: the Susie Bealer, Brown, Mary Belle, Beard, Ada Florence, Union and the Ben Mack. Besides these the Franklin Fluorspar Co. has obtained the Fairview mines in Illinois and the Franklin mine in Kentucky.

Also, early in 1924 the Aluminum interests purchased the Hamp mine in Illinois. In October, 1924, the Hoover mine, next to the Beard property, was acquired. The Haffaw mine was purchased in 1917, and the Memphis mines, the initial purchase, were acquired in 1913.

Marion, Ky. AVERY H. REED

Returning to Gold and Silver

THE EDITOR:

Sir—I need make no apologies, I think, for writing further on the subject of your editorial of Aug. 9 "Returning to Gold and Silver." The return of gold to its rôle of medium of exchange means the restitution of its principal market, of which it has been largely deprived since 1914. The resultant rise in value is of great importance to gold producers. The object of this letter is to point out a factor which seems to have been generally overlooked thus far in considerations of the question.

Your article refers mainly to the British Empire, and remarks herein will be confined to it. It seems to be generally assumed that when, and if, 85s. of British paper money will buy one ounce of gold, the problem is solved and the Empire will only have to declare the sovereign interchangeable with the paper pound for the restoration of a gold monetary system to be achieved. This is not so. The said restoration must increase the use and demand, and therefore the market, for gold. The natural sequence will be a rise in its value. The extent of the rise will depend upon (1) the number of countries that restore gold, (2) the extent to which people demand gold for daily use, (3) the ratio of gold to circulating paper which the nations adopt as safe. Factor (3) may depend mostly upon (2). All three are at present unknown.

In considering such a subject, it is necessary to premise what is a normal state. Inasmuch as in 1914 the world had had a long period of comparative peace and industrial stability, it is reasonable to accept the prewar monetary conditions as our best available criterion of what is normal. It has yet to be proved that something different, based on a different ratio of gold to paper, is satisfactorily workable. So far as I know, no definite scheme for establishing a gold monetary system on a different ratio has been formulated by those who advocate a return to gold on the basis of the pre-war mint price (85s. to the ounce).

Accepting pre-war monetary conditions as normal, can Britain restore and maintain them with a mint price of 85s. per ounce? The cardinal factors are (1) gold is now, say, 10 per cent above pre-war price (in sterling); (2) British price level is, say, 70 per cent above pre-war; (3) the world's gold stocks available for currency are not greatly different from pre-war; (4) the production of gold has fallen from, say, 22,500,000 oz. to, say, 13,000,000 oz. per annum.

Assuming that Britain's wealth and the available gold are the same as pre-war, then to restore pre-war monetary conditions (the pre-war ratio of gold to paper) without disturbing the price level Britain will require about 70 per cent more gold currency (nominal value) than then. To effect this on the basis of 85s. to the ounce will require 70 per cent more gold than pre-war. But if the available gold is about the same as pre-war, how can Britain establish or maintain such a state of affairs? If no other country returns to gold she might do it; the result no doubt being a reduction in America's gold stocks. But if other countries return to pre-war conditions, and assuming the world's wealth to be the same as pre-war, the pre-war demand for gold will also return and the pre-war value. In those circumstances she could not do it.

Whether the world's wealth is, or will soon be, the same as pre-war, I am not able to judge. It is certain, however, that the decrease, if any, is nothing approaching the ratio of 170 to 100.

To meet the difficulty by deflating the price level to the requisite degree is impracticable. If it were practicable, it would be an act of gross injustice and folly. To attempt it would invite a disaster of the first magnitude for Britain.

It is not my purpose, nor have I the requisite data, to indicate figures. My purpose is simply to indicate principles. These are either that a monetary system based on a different ratio of gold to paper must be adopted—and this has not been formulated—or that return to gold, on the pre-war mint price of gold, is not practicable. The assumption that the price of gold falling to 85s. per ounce will in itself enable the restoration of the gold standard in Great Britain is quite fallacious.

Suppose Britain can and does restore gold at the prewar mint price and ratio, being enabled to do so because she acts alone; as other countries restored gold, the demand for it and its value will rise. Britain could then only maintain her ratio by means of calamitous depressions of the price level.

Before satisfactory restoration of gold is practicable, the whole subject of the future effect, on gold value, of the restoration must be closely analyzed and provided for. If future deflations of the price level are to be prevented, it appears that restoration will have to be accompanied by the creation of ample gold stocks—to provide for (1) future extensions of the return to gold, (2) prospective increase in wealth production, resulting from more stable economic conditions.

A question of great interest is the effect that a general (or extensive) restoration of gold will have on the price level in the United States and on monetary conditions there.

Perth, Western Australia. H. R. SLEEMAN.

News of the Week

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Summary

DEBENTURE STOCK totaling $40,000,000 has been sold by the Andes Copper Mining Co., a subsidiary of the Anaconda Copper Mining Co., to finance the completion of the necessary plant for putting the Chilean mines of the Andes company into production at an ultimate rate of 190,000,000 lb. per year.

The Ahumada Lead Co. is producing at the rate of 5,000,000 lb. of lead per month, in Chihuahua, Mexico.

Canadian engineers feel that British investors have themselves to blame in the recent Bingo fiasco.

The Rochester Silver Corporation will resume operations on company account at its Nevada mines.

The Anaconda Copper Mining Co. has reopened its Original mine, one of the largest copper producers at Butte.

Though the copper-tariff survey of the Tariff Commission is complete, no action is expected at this session of Congress.

The price paid by the Comstock Merger Mines Co. for the United Comstock assets was approximately $600,000.

Is It There, or Is It Not? Calumet & Hecla Will Find Out

Thorough Test of Conglomerate and Other Lodes in Michigan Copper Country Planned

If there is any copper in commercial quantity in the famous Calumet conglomerate vein beyond the confines of Calumet & Hecla proper, in the Michigan copper country, the exploratory program of Calumet & Hecla Consolidated should go far to prove it. Examination and investigation of the lode heretofore have been barren of results, and it has been quite generally accepted that the conglomerate was valueless except where opened by the Calumet and the Hecla shafts. However, in accordance with recommendations by eminent geologists who recently completed a three-year survey for Calumet & Hecla, the formation is now to be opened at widely separated points.

Incidentally, other veins will be given attention. At Ahmeek, north of Calumet & Hecla proper, the conglomerate will be opened at depth by means of a crosscut now being driven along the fissure vein at the 17th level of No. 2 shaft. In the old Tecumseh lands, now part of La Salle, to the south, an old shaft sunk to a depth of 1,000 ft. in the conglomerate will be reopened and the conglomerate, Osceola amygdaloid, and other veins investigated. At Cliff, to the extreme north, a shaft is being sunk to examine the Osceola lode and possibly the conglomerate. The Ahmeek crosscut will soon reach its objective; the Cliff shaft is well under way and drifting will proceed in the old Tecumseh shaft in the spring. A power line is being extended to the Tecumseh for operation of pumps.

Anaconda Declares February Dividend; Last a Year Ago

THE Anaconda Copper Mining Co. has declared a dividend of 75c. per share, payable Feb. 16, 1925. The last dividend was for a similar amount paid in January, 1924. The decision to resume payments came as a surprise to Wall Street. John D. Ryan, chairman of Anaconda company, said:

"Dividends are resumed because in the opinion of the directors present conditions and prospects for the metal market are the best they have been since the ending of the war."

Will Exploit Large Sulphur Deposit in Nevada

The Humboldt Sulphur Co., of which Charles S. Haley is president and A. J. Crowley general manager, has purchased the holdings of the Nevada Sulphur Co., at Sulphur, Nev., and plans the immediate erection of a sublimation plant, to produce 10,000 tons of refined sulphur per annum. The equipment now on the property, which provided for the melting of the sulphur in the ore and its recovery by gravity methods, is to be scrapped. The new plant will employ the method described in *Mining Journal-Press* of Nov. 15. Heat and centrifugal force will effect a separation of the sulphur from the ore.

Large amounts of sulphur are being used in the agricultural and fruit-preserving industries, for the preparation of sulphite liquor in the manufacture of paper pulp from wood, and for many other purposes on the Pacific Coast.

Ahumada Lead Co. Produces 5,000,000 Lb. of Metal Monthly

Remarkable Earning Record for Past Two Years—Lead-Vanadium Ore Has Been Found

While the Ahumada Lead Co., operating south of El Paso, Tex., has been paying dividends at the rate of 60c., its actual earnings have approximated $2 per share, per annum. The company is producing about 5,000,000 lb. of lead monthly, it having steadily increased from the beginning of the year to its present volume. The ore carries about 35 per cent lead and 5 oz. silver. Recently, there was found what is reported to promise an important deposit of lead-vanadium ore, which contains above 40 per cent lead, is high in vanadium, and carries about the usual quantity of silver. It is planned, in case there is this amount to be had, to accumulate 10,000 to 15,000 tons of this ore and treat it in a special furnace that will first recover the lead, after which the residue will be run for its content of vanadium.

The bulk of the lead goes to Germany and thus escapes the duty of 1½c. that would have to be paid to market it in the United States.

Since taking over the mines two years ago, the company has constructed and paid for more than 40 miles of standard-gage railway and equipment, opened up the lead-silver deposits in both the Ahumada and Erupcion mines, paid for the property, and today is practically free of debt.

In the output mentioned as from the Ahumada mine is included that of the Erupcion company, in which Ahumada owns a controlling interest. The two properties adjoin.

Comstock Merger Issues $1,500,000 Bonds to Finance Operations in Nevada

United Comstock Mine and Mill Cost $600,000—Ore Reserve 922,000 Tons Averaging $6.85—Tunnel To Be Extended

SINKING-FUND gold notes, payable in ten years, with a face value of $1,500,000 and bearing 8 per cent interest, have been issued by the Comstock Merger Mines Co., which recently acquired the property of the United Comstock Co. at Virginia City, Nev. Goldfields American Development Co., and the Nation Mines Corporation of London control the Comstock Merger Co. The proceeds from the sale of the notes which have been underwritten for $1,200,000 will be used: (a) to repay money loaned, which allowed the company to complete its development work; (b) to pay for the entire assets of the United Comstock Mines Co. which cost approximately $600,000; and (c) to provide funds for the extension of the United Comstock haulage tunnel, into the Comstock merger ground, to connect with the orebodies developed there, and for the preparation of the mine for production.

From June 1, 1922, to Dec. 1, 1924, a total of 37,099 ft. of development work was accomplished as follows: 27,542 ft. of new drifts and crosscuts, 1,230 ft. of new raises, 1,643 ft. of new winzes (used as shafts), 6,119 ft. of reclaimed drifts and crosscuts, and 565 ft. of raises and winzes. This work has, by six levels, developed the Hale & Norcross orebody, over a vertical distance of 741 ft., the Chollar & Potosi orebody, by five levels, over a vertical depth of 400 ft., and the Savage, Gould & Curry orebody, by seven levels, over a depth of 580 ft.

The ore reserves at the end of 1923, taking silver at 60c. per ounce, were estimated at 1,593,000 tons averaging $4.52 per ton. Since that date, development has added a further 227,000 tons averaging $8.75 per ton. Should more selective mining be desired, it is estimated that 922,000 tons of the above averages $6.85 per ton.

In taking over the assets of the United Comstock the company has acquired mining claims which give a further 5,000 ft. along the Comstock Lode, with a haulage tunnel 9,600 ft. long equipped with electric equipment to transport the ore to the mill, a 2,000 ton per day cyanide and milling plant, complete with shops, town buildings, modern surface and underground mining equipment, in addition to mine and mill supplies, and power rebate credits.

The extension of the haulage tunnel to give access to Comstock Merger orebodies is in hand. Driving from the 882 level to connect with the advancing tunnel is also in progress, and it is estimated that by July, 1925, the ore reserves of the company will be made available to the mill by way of this haulage tunnel. The extension of this tunnel passes through the unexplored Exchequer and Bullion claims, regarding which old reports indicate prospects of finding low-grade ore.

The company has realized $1,203,154 from the sale of its shares. The underwritten notes will realize the treasury a further $1,200,000, which it is estimated is sufficient for all requirements. The shares of the company are all issued and outstanding.

Promising Gold Prospect near Bulldog Lake in Manitoba

Surface Showing Good—$12 and $14 Assays Over Fair Widths—Work Continues

During the last summer a small syndicate of Boston men, headed by H. A. Wentworth, acquired a substantial acreage in central Manitoba, not far from Bulldog Lake, and on this promising discoveries have been made. On the ground controlled by the syndicate the main break can be traced completely across the claims and gold has been found at various points over a total length of 7,000 ft.

The largest exposure so far developed is toward the western end of the property, where trenching to date indicates an oreshoot 1,000 ft. long, and which will possibly be found to have a length of 1,500 ft., which gives assays of $12 to $14 over widths of from 4 to 8 ft. Toward the eastern end of the property less work has been done, but trenching indicates the presence of oreshoots totaling at least 400 ft., with more erratic but probably higher values than on the western end. There is a good deal of muskeg on the claims, so that it has been impossible, with the limited amount of work, to determine the full extent of payable ore. So far as surface indications go, this is the most promising new gold discovery made in Canada during the last year, in the opinion of well-posted engineers.

Golden Cycle Will Build 1500-Kw.-hr. Power Plant

The Golden Cycle Mining & Reduction Co., at Colorado Springs, has begun work on the construction of a 1,500 kw.-hr. generating plant to supply the mill and the Midland Terminal R.R. shops with power, which now is supplied by the city of Colorado Springs.

A. E. Carlton, president of the company, says that the construction of this power plant will insure the mill of power at a low cost. This is in line with the company's policy of continued lowering of treatment charges on Cripple Creek ores. The power plant also will provide year-around work for coal miners at the Pikeview mines, as there will be a constant demand for coal for the power plant.

The Golden Cycle mill has averaged a demand of about 8,000,000 kw. annually, and provided a source of revenue to the city of about $75,000 each year.

Anaconda Reopens Original Mine; Will Increase Production

THE Anaconda Copper Mining Co., of Butte, has announced the resumption of active mining operations at its Original mine at Butte, Mont. This is one of the largest and richest copper mines in the district, but has not produced ore for fourteen months. In the meantime extensive alterations and repairs have been made, consisting mainly of retimbering a large part of the shaft. Between 500 and 600 men will be employed when the mine reaches its normal production.

Iron Cap Copper Co. Purchases Property in Coyote District

It is reported that the Iron Cap Copper Co., of Globe, Ariz., has recently completed arrangements to take over the claims of Ignatius Calvillo in the Coyote district, and is already making preparations to establish a camp there. The property is some 38 miles from Tucson, near the Ajo highway, and has been a high-grade producer in the past.

New Development in Utica Mine May Disclose Ore

After an advance of 500 ft. on the No. 5 or lowest level of the Utica mine, near Kaslo, B. C., a vein has been encountered which bears promise of disclosing an oreshoot.

The Utica mine belongs to the Canadian Mines Merger, a company recently organized by H. H. Armstead in which several promising properties of British Columbia have been included.

The mine has been a producer of high-grade silver-lead ore; 1,000 tons of ore shipped gave returns of 170 oz. of silver and 22 per cent lead.

The property presents some complex geological problems; local faulting, intrusions, and disturbances have changed the strike and dip of the vein so that investigations by other operators have failed to disclose the vein in depth. The new discovery may furnish a key to the solution of the geology.

Hamilton and Joralemon Get Option in Nevada

The Treasure Hill mines, near Hamilton, Nev., have again changed hands, according to current reports. The Treasure Hill mines were under option to the Tonopah Mining Co. during the last year, and considerable development work was accomplished without discoveries of importance. This option has been relinquished and it is reported that a new option has been granted to San Francisco interests represented by H. T. Hamilton and Ira B. Joralemon. These operators are also reported to hold an interest in practically all the smaller properties held by companies along the course of the old producing area of the district, covering a total distance of more than five miles.

Spend $8,767,924 in Wages to Smelt $227,735,149 Worth of Lead

THE output at the lead smelters and the refineries of the United States during 1923 was valued at $227,735,149, an increase of 51.2 per cent over the value of the output in 1921. The figures are those of the biennial census of manufactures. The 1923 output came from twenty plants, of which thirteen did smelting only, three refining only, and four both smelting and refining. The payroll at these establishments aggregated $8,767,924, an increase of 47.2 per cent.

Holly Consolidated Concentrator Treats 75 Tons Daily at Eureka

Hope to Open Bonanza Orebodies—New Development Planned—Good Mill Reserve

The Holly Consolidated Mining Co., operating on lead-silver ore at Eureka, Nev., produced $30,000 worth of concentrates during November.

The Holly oil-flotation and concentrating plant is working successfully on Eureka ores, treating 75 tons per day. All the ore being handled at present is being mined from between the 300 and 600 levels, although it is reported that development will be resumed on the 900 level soon.

The company controls, either through stock ownership or option, more than 300 acres of well-situated ground in the Eureka district. Work in the limited area under development indicates a large tonnage of ore of mill grade, in small and large orebodies, with the ever-present possibility for the discovery of bonanza orebodies such as were worked during the early days of the camp.

Oliver Starts Big Stripping Job on Western Mesabi

A big job of stripping has been started by the Oliver Iron Mining Co. just east of the Canisteo mine, near Bovey, on the west end of the Mesabi range. Four forties will be stripped during the next ten years, about 1,000,000 yd. being removed each year. One model 300 Marion shovel taken from the Prindle mine at Kewatin is at work on double shift and will be kept busy during the winter.

Rapid preparations are being made to get the Miller mine at Aurora on full production again. The old steam equipment is being used at present, but plans are under way to make a complete electrification at this mine. Shovels, locomotives, and shops all will be operated by electricity.

The McKinney Steel Co. is removing its equipment from the St. James mine, at Aurora. There is still about 5,000,000 tons of ore in this mine, but from the way tracks are coming out, and all the engines and shovels, it appears it will not be taken out by this company as its lease runs only to Jan. 1 and has not been renewed.

Anaconda Will Proceed with Equipment of Andes Copper Property

Arrangements Completed for $40,000,000 Financing—Construction of Reduction Works and Necessary Adjuncts To Be Resumed in 1925—Annual Production of 190,000,000 Lb.

By A. B. Parsons
Assistant Editor

RESUMPTION of active development and construction operations at the property of the Andes Copper Mining Co., subsidiary of the Anaconda Copper Mining Co., is planned early in 1925. The holdings comprise 272,000 acres of land at Potrerillos, Chile, 90 miles from the coast in the main range of the Andes. Chanaral, the seaport, is connected with the mines by a railroad, 60 miles of which was built by the Potrerillos Railway Co. especially to serve the mines.

The company discontinued large-scale work in 1921 after spending about $19,000,000 to develop 137,400,000 tons of 1.51 per cent copper ore. The anticipated output is 190,000,000 lb. of copper per year at an average cost of 6.672c. per pound before depreciation, depletion, interest and taxes. This scale of production is not expected to be realized within four years or more, as practically no work has been done on the construction of reduction plants.

The National City Co. is floating $40,000,000 in 7 per cent debentures, convertible at 44 shares of stock for each $1,000 in debentures. The authorized capital stock is to be increased to 3,600,000 shares, of which 1,760,000 or 99.87 per cent of the total outstanding, will be owned by Anaconda and 1,760,000 will be held in reserve to provide for the conversion of the debentures. Anaconda does not undertake to guarantee the new issue, but will retain a half interest and control of the property.

The Andes company has expended during the last eight years nearly $20,000,000 cash in investigation, experimentation and development of the orebody; in purchasing mining equipment; and in the construction of town, railway lines, and port facilities. The proceeds of this issue of $40,000,000 debentures, as paid in from time to time, will be utilized in the completion of the mining development; the construction of the metallurgical plants and power plants and transmission lines; the purchase of railway equipment; and to supply working capital for the developed property.

The reserves of proven ore now blocked out, including only that with a copper content of 1 per cent or more, are estimated at 137,400,000 tons averaging 1.51 per cent copper, consisting of 48,400,000 tons of oxide ore and 89,000,000 tons of sulphide ore. On the basis of the anticipated output of 190,000,000 lb. of copper per annum upon completion of the construction program, these reserves, without including a large tonnage of proven ore of less than 1 per cent copper content, and without including undeveloped deposits known to exist in the property, assure an operating life considerably beyond the maturity date of the debentures, according to the statement of the National City Co.

It is understood that the first work will be the erection of a concentrator to handle 12,500 tons of sulphide ore daily. This will require from two to three years, after which a leaching plant capable of treating 7,500 tons of oxidized ore daily will be erected. A feature of the process for treating oxidized ores will be the use of sulphur dioxide, followed by iron cementation, for the precipitation of the copper. Experiments in a large test plant indicated a consistent extraction of 92 per cent of the coper in the oxide ores.

This program, with the completion of a steam-turbine electric generating plant at Port Chanaral, with the necessary transmission lines and the equiping of the mine for operation, will require about four years, so that the full proposed output of 190,000,000 lb. per year will be deferred until some time in 1929.

The orebody, as so far developed, is about 1,800 ft. long, 900 ft. wide, and 850 ft. deep. It is an impregnated porphyry intruded in limestone. Unlike the Chuquicamata deposit of the Chile Copper company, underground mining by a caving system will be necessary, as the overburden is too thick for economical stripping.

The cost of developing a large copper producer is well shown by the following chief items in the expenditures made to date by Anaconda at the Andes property: Mine development, $3,863,781; construction, $4,922,374; general expenditures, $3,149,062; equipment, $660,821; Potrerillos Railroad, $3,464,110; experimental and research work at Potrerillos, $458,671; New York and Montana expenditures, $1,552,036.

To complete opening up of the property and provide mill, leaching plant, and smelter an additional $32,300,000 is necessary. This makes the total cost of equipping and opening up the property more than $51,000,000, and an additional $6,500,000 must be provided for supplies, starting expenses, working capital, and for carrying copper in process at mine and plant. In other words Andes will have a capital development-equipment expenditure of approximately $1 for every four pounds of copper of annual production.

Officials of the Andes company estimated that, upon completion of the development program, copper can be delivered from the mines to New England points at an average cost before depreciation, depletion, interest and taxes of 6.672c. a pound. On this basis, the estimated income available for interest and taxes, before depreciation and depletion, on an anticipated annual production of 190,000,000 lb. of copper ranges from $12,057,877, at an average market price of 13c. a pound, to $21,585,277 at an average market price of 18c. a pound. Annual interest charges on this new issue will ammount to $2,800,000.

Rochester Silver Corporation Will Resume on Company Account

Property Leased After Pittman Act—Lessees Made Big Profit

At a meeting of the board of directors of the Rochester Silver Corporation, held in Chicago on Dec. 5, it was decided to resume operations at the Rochester mine, in Nevada, on company account instead of on a lease basis, as has been followed during the last year.

The Rochester ore is comparatively low grade, and when the Pittman Act silver purchases were completed it appeared doubtful if the property could continue operations at a profit at 65c. silver. The entire mine and mill were leased on a 50-50 basis, and operations were so successful that earnings for the fourteen-month period prior to July 1924 averaged $11,000 per month, or considerably above expectations.

In July shortage of water affected the power supply and caused discontinuance of operations, and nothing has been done since that time. J. A. Burgess was recently retained to make an examination of the property, and it was due to his recommendations that the directors decided on company operations in the future.

Treadwell Mill Finished

A radiograph from Mayo, Yukon Territory, states that the Treadwell company has 20,000 tons of ore mined, and that the mill is practically complete and will be put into operation before the end of the year.

Burma Mines Produced 25,000 Tons of Ore in November

During the month of November 25,101 tons of ore was mined by the Burma Corporation at its mines in the Shan States. A total of 24,000 tons of ore was milled in the treatment plant, producing 11,849 tons of lead concentrate; 12,787 tons of lead-bearing material were smelted in the blast furnaces, producing 4,855 tons of hard lead for treatment in the refinery. Refinery products were 4,550 tons of refined lead, and 472,000 oz. of refined silver. Of silver production 13,000 oz. was recovered from the treatment of copper matte. The experimental zinc plant produced 2,023 tons of zinc concentrate, assaying 11.36 oz. silver, 7.91 per cent lead, and 45.77 per cent zinc.

In addition to above-recorded production, 300 tons of copper matte was produced from the treatment of accumulated smelter byproducts and 1,698 tons of copper ore, as well as 300 tons of antimonial lead.

Premier Highway Cut-off Reveals $800 Ore, Is Report

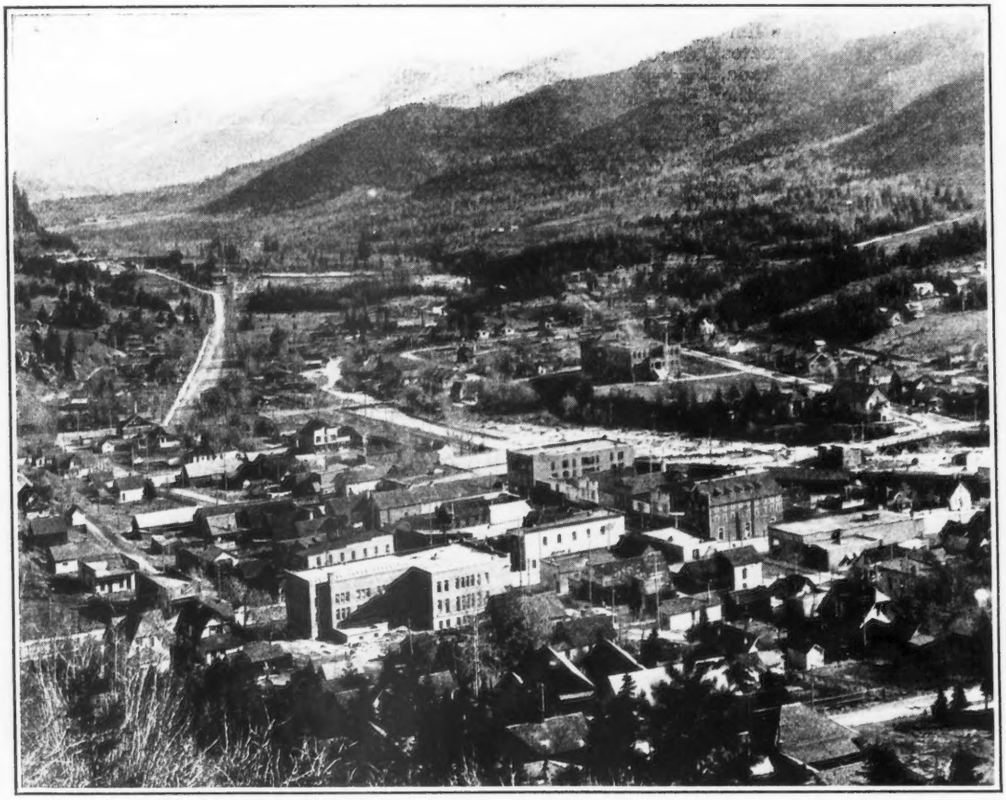
Workmen constructing a two-mile cut-off in the road between Hyder, Alaska, and the Premier mine have uncovered bonanza ore. One sample assayed $800 per ton in gold and silver. Claims have been staked on each side of the road. Officials of the Premier company are reported to be sampling the discovery thoroughly. The results of these assays, however, have not been made public.

Consolidated M. & S. Employees Given Share of Stock

Christmas Present Goes to Those Who Have Worked Three Years

Employees of the Consolidated Mining & Smelting Co. of Canada have received the following notice: "In appreciation of the prevailing spirit of co-operation among employees, with the sanction of the board of directors, each married employee who will have been in the service of the company three years continuously on Jan. 1, 1925, will be entitled to one fully paid share of the company's stock, and each unmarried employee who will have been three years continuously in the company's service on Jan. 1, 1925, will be entitled to one-half of one fully paid share in the company's stock — such unmarried employee, however, to have the privilege (a) of paying $12.50 and thereupon being entitled to receive one fully paid share in the company's stock; (b) of retaining his right to the half share and obtaining the other half upon his being married in the year 1925. Furthermore, as an employee attains three years continuous service after Jan. 1, 1924, a similar privilege will be extended to him—to be effective on the first of July or the first of January following the completion of his three-year term."

As Consolidated stock in being quoted on the Montreal Exchange at $48, the gift to employees is nearly double what it appears to be. The company has declared a dividend of 3 per cent for the half year ending Dec. 31, 1924, making 6 per cent for the year.



Mullan, in the Coeur d'Alene region in Idaho

The district has a number of attractive towns, as mining camps go. The large building in the foreground is the Morning Club, built by the Federal Smelting and Refining Co. for its employees.

Automobile Lines to Cripple Creek Not "Public Necessity"

Colorado Utilities Commission Stops Competition for Midland Terminal Railway

The Colorado Public Utilities Commission opposes the operation of automobile truck and passenger service in competition with rail service for mountain mining camps under certain conditions.

The Midland Terminal Railroad Co. operates a line of road between the Cripple Creek district and Colorado Springs. Its chief business is the movement of ore from this district to the Golden Cycle mill, at Colorado Springs, and incidentally to take care of other freight and passenger traffic to and from the district.

The road is owned and operated by the mining interests, and has no business other than that which directly serves the district. Without it as a transportation agency to the reduction plant at Colorado Springs the camp could not have service.

The commission has just held that the motor company has failed to establish the fact that motor transportation is a public convenience and necessity, especially when the service rendered by the Midland Terminal R.R. is taken into consideration.

Inspiration Reciprocates by Supplying Power to Phoenix

Arizona's prolonged drought has caused a shortage of water in the reservoir at Roosevelt and has cut down the power generated by the plant at the dam to a small fraction of the normal amount. Most of this power is used in operating pumping plants in the Salt River Valley irrigation area. The city of Phoenix also obtains its electricity for its street railway, lights, and domestic use from this source. In view of the shortage of power at the dam the Inspiration Copper Co. is furnishing the irrigation district with power as well as supplying the Inspiration mine and mill and the International smelter.

Better conservation of the water at Roosevelt will be possible when the new dam at Horse Mesa has been constructed. With the completion of this project, which is now under way, the power plant at Roosevelt will be able to supply the needs of both the irrigation district and of the copper company the year round. The site of the Horse Mesa dam is below that at Roosevelt. The new dam is being built for the purpose of storing the water which passes through the Roosevelt generating plant.

Mines Hall at Seattle Burns

Mines Hall, containing offices, classrooms, and ore-dressing and metallurgical laboratories, of the College of Mines at the University of Washington, at Seattle, burned on Dec. 16. Students saved the library books and some light apparatus, but government publications and important specimens of ore and mine maps were lost, with much equipment. Courses will be continued without interruption in the mines laboratory, erected three years ago.

Gold Producers Exempted From Income Tax in Australia

GOLD producers in Australia are now exempted from the payment of income tax to the Commonwealth Government and the exemption also applies to dividends paid by a gold-mining company. The clause reads as follows: "The income derived by a person from the working of a mining property in Australia, principally for the purpose of obtaining gold or gold and copper, provided that in this case the output of gold shall not be less than 40 per cent of the total value of the output of the mine; this exemption shall extend to dividends paid by a company out of such income."

Washington News

By Paul Wooton

Special Correspondent

Copper Tariff Survey Complete; No Immediate Report

Congress Opposed to Tariff Hearing This Winter—"Reconditioned Scrap" Metal Important Factor

Though the preliminary report of the results of the survey of copper has been submitted to the Tariff Commission by its staff, the results probably will not be made public for several weeks, as the commission has not reviewed the report and must decide which of several factors of calculation suggested shall be adopted for incorporation in the final report.

The survey was undertaken by the commission under its ordinary powers at the request of a committee of Michigan producers of copper ore who have organized to secure, if possible, a protective tariff on copper and who set forth in correspondence with members of Congress and with the Tariff Commission that the industry in Michigan is greatly depressed because of heavy imports of ore. When the survey is completed, the data will be made available to the industry and to Congress, should the legislative body make a request for information on the subject.

Before finally determining the form of its survey report, the Tariff Commission will consult representative men in the copper industry regarding trade practices, technical details, and statistics, this course being followed in the cases of all ordinary surveys.

It is understood that one of the points to be decided by the commission is whether reconditioned scrap copper is to be included in domestic production or treated separately. In any event, there will be no legislation on the subject of a copper duty during the present session of Congress, and probably there will be no hearings on the James bill to impose a duty. The majority members of the House Ways and Means Committee and of the Senate Finance Committee are strongly opposed to any tariff hearings this winter.

Melbourne Letter

By Peter G. Tait

Special Correspondent

Will Develop Wiluna Gold Property in Australia

Gwalia Consolidated Will Finance Operations in London—Railway Promised

Melbourne, Nov. 15—It is reported that the bores put down by the Gwalia Consolidated property at Wiluna, Western Australia, have proved the orebody to be up to anticipations, and an announcement as to the steps to be taken to develop the mine is awaited with interest. J. McDermott, manager of the Ivanhoe company, Kalgoorlie, is the representative of the syndicate which holds the option. A company with a capital of at least £300,000 will probably be organized in London. The Western Australian Government has given assurance, if the bores were satisfactory and provided a company was formed with a sufficient capital, that it will build a railway to the district. In view of the depressed condition of gold mining in Australia recently the prospect of a large company being formed is very encouraging.

The Mararoa Gold Mining Co., which operated a very profitable mine in the Norseman district, Western Australia, and which has recently been endeavoring to find another mine worthy of development, has taken an option over certain leases adjoining the Gwalia Consolidated mine and is now testing the ground by diamond drilling.

More Trouble for New Guinea Copper

The New Guinea Copper Co. in Papua has met with a further misfortune by a fire which has occurred in the Laloki mine. According to the reports received by radio a heavy fall of ore occurred in a winze and this caused a fire which immediately spread to the timber. Efforts to smother the fire have apparently been unsuccessful, and the general manager is seriously considering the flooding of the workings. The new blowing engine which had been installed was about to be put into commission and the production of blister copper resumed. The company has had many setbacks and has never, it is believed, been in a position of profitable production.

Considerable public interest has been manifested by the report that gold had been discovered in the city of Melbourne during building operations. One of the property owners has applied for a lease and announces his intention to sink a shaft. Geologists, however, do not take the discovery seriously, and whilst admitting that a few specks of gold may be found, consider there is little probability of any payable reef. This is not the first occasion that similar finds have been made. The nearest payable gold field to Melbourne was at Warrandyte, about 18 miles out, where a considerable quantity of alluvial gold was recovered. In the same district also one or two profitable mines have been worked on rich orebodies, but very little work is being carried on today.

Johannesburg Letter

By John Watson
Special Correspondent

Increase Makes October Second Month in Gold Production

Brakpan, Crown and Government Areas Register Big Increases—Lydenburg Platinum Shares Sell Well

Johannesburg, Nov. 18—The Transvaal gold output for October was declared by the Chamber of Mines as 827,583 oz., having a value of £3,786,-192. These figures show an increase of 28,161 oz. and £108,851 in realizable value over the month of September. The output for July was the highest this year, the October output coming second. Among the most notable increases, Brakpan, Crown Mines and Government Areas each showed over 3,000 oz., and Randfontein had an output 2,485 oz. higher than its September figure. The native labor returns show an increase of 548 "boys" working on the Rand gold mines, the total number that were employed on Oct. 31 being 177,954.

From the alluvial fields of the New Vaal River Diamond & Exploration Co., the output for October amounted to 1,175 carats, of the value of £11,474, or £9 15s. 3d. per carat, and showing a return per digger of nearly £100.

On the Johannesburg Stock Exchange, the feature of last week's business was the activity in the shares of companies holding land in the Lydenburg district in the vicinity of the recently reported rich finds of platinum on farms of the T. C. Lands Co., the shares of which were bought in tens of thousands at advancing prices. T. C. Lands shares rose from 23s. 6d. to 25s. 6d., closing the week with sales at 24s. 3d.

Crushing results from the leading gold mines of the Rand, arranged in order of profits earned, have recently been published, for the month of October:

	Tons Crushed	Value or Revenue £	Costs per Ton Milled, s.	d.	Estimated Profit, £
Government Areas	169,000	347,753	16	8.0	210,162
New Modder	127,000	271,370	16	11.2	163,855
Crown Mines	223,000	299,641	19	2.0	85,944
Van Ryn Deep	68,300	138,170	18	9.7	75,044
Modder Deep	45,500	108,822	15	11.0	72,619
Springs	67,600	129,039	20	4.6	66,484
City Deep	99,000	176,765	22	7.1	64,948
Randfontein Estates	201,500	244,619	18	10.1	58,411
Modder B	67,500	119,704	18	5.3	57,462
Brakpan	79,000	129,036	20	3.5	55,250
Robinson Deep	77,000	.....	16	10.9	46,576
Geduld	71,000	112,115	18	7.0	46,014
New State Areas	67,000	110,967	20	11.7	41,034

The South African banks have twice raised their rates of exchange, by one-half of 1 per cent each time, during the past month. This operates against the exporters of gold from South Africa and in favor of the importer. The price of fine gold having now fallen to 90s. per ounce, the net realized price is within 2s. or 2s. 6d. of the point at which the gold mines will probably decide to have their gold minted at Pretoria. Up to date, only silver and bronze coins have been minted at this new mint, to any extent.

The monthly wage bill of the Rand gold mines amounts to approximately £1,000,000, and it is possible that these wages may very soon be paid in gold sovereigns, fresh from the new Pretoria mint. If the greater part of the Rand gold output were minted at Pretoria, the banks would be confronted with the task of exporting the coin overseas at their own expense and they would lose the £750,000 with which they are now debiting the mines.

Brisbane Letter

Special Queensland Correspondence to Mining Journal-Press

Financing of Mount Isa Mines Being Arranged in London

Treatment Plant Assured If Development Continues Satisfactory—9,000 Tons of Ore per Foot of Depth

Brisbane, Nov. 3.—News has been received by cable that W. H. Corbould, chairman of directors of the Mount Isa Mines, Ltd., who is now in London, has brought to a conclusion his negotiations there for the raising of capital for his company. A financial firm has agreed, after enough development work has been done on the company's silver-lead mines to prove to the satisfaction of an outside expert that these can supply sufficient ore to warrant the erection of a treatment plant, to lend £500,000 at a low rate of interest. The directors of the company have notified the shareholders that thirty shafts have been sunk, mostly to a depth of 80 ft. and more, to show the extent and dip of the many lodes outcropping on the surface. Owing to the unusually safe and soft nature of the country, which makes possible low mining costs, very rapid progress, they say, has been made, 4,000 ft. of sinking, driving and crosscutting having been done in about six months with hand methods only.

The principal lodes developed to date by the Mount Isa company are the Black Star, Black Rock, Rio Grande, and the Isa. On the first-named a depth has been reached of 218 ft., where average assays give 16 per cent of lead and 2 oz. of silver per ton; the Black Rock, at 155 ft., shows 31 per cent of lead and 16 oz. of silver over the whole width of the shaft; and in the Rio Grande, on the Black Rock lode, the average is 30 per cent of lead and 19 oz. of silver, also over the full width of the shaft.

The mine superintendent of the company considers that, so far as can be seen from the width and length of the orebodies now being proved at the 80 level, there is evidence that 900,000 tons of highly payable ore may be expected from each 100 ft. of depth, exclusive of ore from untouched lodes. The directors are confident that the prospecting and development policy now being pursued will prove during next year that the property fully warrants the installation of a plant capable of handling a big tonnage of ore.

The water shortage, mentioned by A. W. Newberry in his article in the *Mining Journal-Press* of Aug. 2, as the principal difficulty at the cobalt mine, in the Cloncurry district, still exists, and is seriously hampering operations. Because of this condition, the mill has been idle since June 17, but crude ore is being shipped to Europe in regular lots of about 100 tons a month. The September lot, consisting of 94 tons, contained 16 tons of cobalt, worth £3,290.

London Letter

By W. A. Doman
Special Correspondent

London Is Suspicious of Canadian Mine Flotations

Davidson and Bingo Episodes Hurt—Earl of Hardwicke Resigns From Bingo Board

London, Dec. 10—Following upon my remarks of last week concerning the Davidson mine and the discrepancies in the findings of the various engineers who have reported upon the property, comes another shock to the British public. The Bingo Gold Mines offered an issue of 125,000 preferred shares in London in March, 1922. Very high opinions had been formed of this property over here, and the shares rose to 25s., a figure which, without some backing, is somewhat high for a mine that has not yet reached the producing stage and that has relatively so little development work done. Recently the chairman, the Earl of Hardwicke, resigned from the board, and this was regarded in some quarters as a warning signal. Since this the shares have fallen and are now at only the nominal figure of 7s. 6d. Naturally, shareholders have exhibited a certain degree of restlessness, and have been surprised by the issue of a statement by the board saying that as some recent sampling of crosscuts has failed to confirm previous values, the company has engaged John A. Dresser, past-president of the Canadian Mining Institute, to make a complete examination and valuation of the mine, and adding that Mr. Dresser is at present on the property. As this statement comes on top of the Porcupine-Davidson affair, the Canadian mining market is certainly under a cloud. The British public is willing to invest money in Canadian mining undertakings, but having been so badly hit by worthless shares sold to them by means of circulars, and having lost money in the Porcupine-Davidson and the Bingo, they are hesitating at the moment in touching even the really good things in the Dominion.

It is hoped that the East Pool & Agar Co. (Cornwall) may be able, as a result of the operations during the current year, to declare a dividend on the ordinary shares when the accounts are made up. Monthly returns have been steadily improving, and within the next few months production is expected to expand. Eight heavy stamps have been erected and six of them are now running full time; a seventh should be put into operation soon. To cope with the water difficulty a big Cornish pump is being installed, and this necessarily checks underground work, which, however, will be largely extended at a later date.

The private lead manufacturing companies of Messrs. Locke, Lancaster, and W. W. & R. Johnson & Sons, of London; Cookson & Co., of Newcastle-on-Tyne, and Rowe Brothers & Co., of Liverpool, are to be amalgamated. Holders of the three companies will be given shares in the Associated Lead Manufacturers.

Two Australian Enterprises Report Highly Successful Year

Electrolytic Zinc Co. and North Broken Hill Pay £625,000 in Dividends—Manufacture of Superphosphates

Special Correspondence

Highly satisfactory results were achieved in the year ended Sept. 30 last by the Electrolytic Zinc. Co. of Australasia, Ltd., whose chief enterprise consists of large ore treatment works at Risdon, in Tasmania. Net profits are stated at £341,349, compared with £285,406 for the preceding term, and these figures do not cover new superphosphate works, which are now so far completed as to become a factor in revenue and outgo.

For the year, £169,131 has been paid in dividends, and, after allotting large sums to a debenture sinking fund and other purposes, there is a balance of nearly £99,000. Since the close of the financial year, too, a further dividend has been paid, amounting to more than £95,000. The manufacture of superphosphates was to have begun in October last, and production from these works was to be in the first place at least equal to the total consumption of Tasmania. The assets of the company total over £4,000,000.

Consequent upon a proposal approved by the North Broken Hill Co., New South Wales, twelve months previously, to acquire the whole of the interests of the British Australian Broken Hill, Ltd., the capital of the former company has been increased from £600,000 to £700,000. The British mine was taken over in October, 1923.

In the year ended June 30 last, sulphide ore amounting to 336,679 tons was treated, and produced 86,198 tons of lead concentrate as well as 55,879 tons of zinc concentrate. Ore reserves of the mine above the 1,550 level are estimated by the manager at approximately 3,750,000 tons. The revenue for the year totaled £1,505,932, and the balance to profit-and-loss account at the end of the term was £686,793. Dividends totaling £455,000 were paid, and substantial amounts were carried forward to special funds, leaving a balance of about £300,000.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Canadians Resent Reflections on Mining Situation in Ontario

Too Many Amateurs Handling Properties—Investors Should Demand Reports by Real Engineers

Though official statements are not yet forthcoming, it is understood that the recent sampling of the Bingo mine in Northern Manitoba by J. A. Reid and J. A. Dresser are not encouraging. *The Financial Times*, of London, criticizes the directors in having Mr. Dresser, a distinctively Canadian engineer, make a report on the property, and though giving credit to his reputation, thinks that the British public, who are the large holders of the shares, would be better satisfied if an English engineer had been appointed. It is further understood that the English directors have now appointed another engineer, whose name has not yet been disclosed, to make a further report.

This is something which should have been done before, as English investors were advised over a year ago that Canadian engineers did not consider this property highly and were dubious of the extravagant statements which were made regarding widths and values. London papers will no doubt again ask, as they did in connection with the Davidson fiasco, what is wrong with Canadian mining? The answer appears to be that there are too many amateurs handling mining properties, where the best technical advice is needed. Until the appointment of J. A. Reid, no engineer of standing had ever looked at the Bingo and it was the policy of the company never to allow any visiting engineers to even see the property, much less examine it. Canadian mining interests believe that they are the ones who should feel resentful over such fiascos as these, where a big and profitable industry is being brought into disrepute by the utter lack of ordinary business methods.

Nesbitt, Thomson & Co., of Montreal, are offering an issue of $3,500,000 Canadian Northern Power Corporation, Ltd., 7 per cent cumulative preference stock, which has a par value of $100. Shares are being offered at 99 and are redeemable in whole or in part, at any time, at 110 and accrued dividend. This is the new company which has taken over the Northern Canada Power Co., which supplies the Porcupine district and which has also the Quinze development, which will no doubt supply power to the new district of Rouyn.

The authorized capital of the new company is 75,000 shares of $100 par 7 per cent preference stock and 75,000 shares of no par value common stock. A bonus of common stock will be given with the preferred. Gross earnings for the present year are estimated at $933,000, with estimated net earnings of $434,000, before depreciation. Though no official announcement has been made, it is understood that the transaction whereby Nesbitt, Thomson & Co. have taken over the Northern Canada includes an agreement with the Hollinger Consolidated whereby the latter company will be relieved of further responsibility in connection with its power development at Island Falls, on the Abitibi River, and it is also believed that this power plant will eventually to be taken over by the Abitibi Pulp & Paper Co.

During the last few weeks more new discoveries have been made in the silver camps than in any other mining sections of the province, the latest one being a new shoot of ore opened up in the Crompton lot of the Mining Corporation, in South Lorrain. This shows 10 in. of 3,000 oz. ore and has already been opened up for a length of 20 ft. Another discovery has also been made on the Keeley in the eighth level drift toward the Keeley Extension property. This is the second discovery made on this level within a comparatively short time, and adds a good deal of speculative value to the Keeley Extension ground. It is understood that the Huronian Belt will soon form a new company and make a new flotation of the Keeley Extension.

Large concrete thickener tank recently built by the Phelps Dodge Corporation at Morenci, Ariz.

Societies, Addresses, and Reports

Engineers Discuss Influence of Drought on Mining in California

THE Section on Mineral Resources of the Commonwealth Club of California (Walter Stalder, chairman) is making an intensive study of the effect on Californian mining of the recent drought. A joint meeting of this section, the Scientific Research Section, and the San Francisco Section of the Institute was held at San Francisco recently. W. J. Loring made some interesting remarks on the effect of the lack of water at Plymouth, Calif., during the summer months. For eight weeks or so no fresh water was available. Tailing from the mill of the Plymouth Consolidated was impounded, and the excess water returned until its consistence was such that the metallurgical efficiency of the plant was impaired. For the domestic requirements of the town, of 700 inhabitants, water was hauled by motor truck for a distance of three and one-half miles during this period. These conditions were not shared elsewhere, but the experience should prompt a realization of the additional loss that would be incurred if a succession of such droughts were to occur. During the period under consideration the output from the Plymouth mine was reduced one-half, entailing disorganization and loss.

J. M. Hill, of the U. S. Geological Survey, spoke of the probable output of metals from the state of California for 1924. The drought, he maintained, did not affect gold mining as a whole to any appreciable extent. Placer mining operations were continued at a normal rate. Hydraulic mining suffered—the longest run was measured in weeks, the shortest in hours—but this source contributes so little to the total output that the effect of the drought was insignificant. The yield from dredges will probably be less in 1924 than it was in 1923. More gravel was made available for exploitation, on account of low water in the rivers, and prospecting was stimulated thereby; but returns show that the small operator, generally speaking, was unsuccessful in his quest for gold. New ground did not yield as anticipated. Copper production in California, Mr. Hill averred, would be larger in 1924 than it was in 1923. Lead will show a decline. Zinc will reappear among the metals produced in the state. Silver output will be slightly smaller.

Abbot A. Hanks, chairman of the subcommittee on placer mining, made a plea for the co-operation of the various interests dependent on water for the success of their enterprises, and for an end to the selfish antagonism shown toward the mining industry in the past, which led to the introduction of the drastic restrictions against the operation of placer deposits. This legislation served to kill the industry, despite the fact that immense reserves of payable gravel are known to exist. The subject needs reconsideration. The cessation of hydraulic mining has not benefited the agriculturist to the extent imagined. A vast amount of débris is carried down by natural runoff, damaging agricultural property. Dams are needed for the collection of such débris, to provide water for power, for irrigation, and for the operations of the mining companies.

Mr. Hanks mentioned it as a significant fact that mining companies operating on rivers below power plants experienced no trouble during the recent dry period. If sufficient restraining dams were built, the result would be advantageous to the agriculturalist. The small hydraulic miner, however, cannot afford the expense; and the subject becomes one of state if not of national interest and concern.

Engineering Council Will Meet Jan. 16 and 17

The annual meeting of the American Engineering Council will be held in Washington Jan. 16-17, 1925. The administrative board of the council will convene there on Jan. 15. Co-operation of the engineering societies of the United States with the Federal Government in carrying out the provisions of the Clarke-McNary Act, and the policy of the engineering profession on the question of consolidating the public works functions of the government will be among the principal topics considered.

Interpreting the recent action of the administrative board as to public works, the president of the council, James Hartness, said that the American Engineering Council would aggressively endeavor to have included in the proposed Division of Public Works all of the construction work now done by the government.

Advocates of Metric System to Hold Annual Meeting

The annual meeting of the Metric Association will be held in Washington, D. C., in Corcoran Hall, Dec. 29 to 30. The President, Dr. George F. Kunz, will deliver his annual address on Monday. The program includes a number of interesting papers and a visit to the Bureau of Standards.

Brussels Will Hold Fair

The Sixth Official Brussels Commercial Fair, an annual international business exposition, which has become one of the most important fairs of Europe since the war, will be held from March 25 to April 8, 1925, in the gardens and halls of the Cinquantenaire, Brussels. Full particulars can be obtained by addressing the Executive Committee, 19 Grand 'Place, Brussels, or at the Belgian Consulate in New York City, 25 Madison Ave.

Next Field Meeting of A.I.M.E. to Be Held in Salt Lake

John V. W. Reynders, vice-president of the American Institute of Mining and Metallurgical Engineers, was the guest of honor of the Utah Section of the Institute, at its monthly dinner held at Salt Lake City in the Newhouse Hotel, recently. Mr. Reynders announced to the members and their guests, who numbered about one hundred, that Salt Lake City would be the meeting place for the 1925 annual convention of the Institute, to be held during the coming summer. Mr. Reynders said in part:

"My knowledge of Utah's great mineral, scenic, and recreational resources, as well as of its wonderful mines and metallurgical plants, convinces me that the opportunities for making the one hundred and thirty-second meeting of the organization a success are unsurpassed. Salt Lake, being the center of the Western mining industry, is the logical place to hold a convention in this section of the country."

Among the papers read was one by H. T. Plumb, of the General Electric Co., on "Dynamic and Regenerative Breaking"; and another by Daniel Harrington, formerly of the U. S. Bureau of Mines, on "Comparison of Coal and Metal Mining Methods."

Arizona Chapter of A.M.C. Elects Officers

Appointment of a committee of five prominent mining men whose duty it shall be to promote the more direct use of copper in the State of Arizona, was the outstanding feature of the annual meeting of the Arizona Chapter of the American Mining Congress, held at the Hotel Adams, in Phoenix, recently. Officers for the ensuing year were elected at this meeting as follows: G. M. Colvocoresses, of Humboldt, governor; W. S. Boyd, of Ray, first vice-governor; J. C. Greenway, of Warren, second vice-governor; F. W. Maclennan, of Miami, third vice-governor. The board of directors for the ensuing year will consist of Robert E. Tally, F. A. Woodward, G. M. Colvocoresses, W. G. McBride, J. Kruttschnitt, Jr., P. G. Beckett, F. W. Maclennan, T. H. O'Brien, P. E. Koerner, T. O. McGrath, James S. Douglas, J. P. Hodgson, W. S. Boyd, and John C. Greenway.

Washington State College Offers Practical Course

Miners and prospectors are being offered a twelve-weeks' course in mining, geology, assaying and ore testing, metallurgy, mineralogy and surveying by the School of Mines and Geology of the State College of Washington at Pullman, Wash. Classes will begin Jan. 5, 1925.

The object of the college in offering these courses is to assist mature men interested in mining who have not had the time or perhaps the preliminary training necessary to enter the four-year collegiate course in mining and metallurgy.

Men You Should Know About

Eugene Dawson, consulting engineer, is in Southern California on professional business.

Ira B. Joralemon, consulting geologist of San Francisco, was a visitor to the Bisbee district recently.

Leonard T. Pockman, manager of the Los Angeles office of the Chicago Pneumatic Tool Co., is in New York.

W. L. Home, superintendent for the Greenstone Products Co. of Thurmont, Md., was a recent visitor to New York.

Daniel M. Armstead, mining engineer, has become a director of Perkins Macintosh Petroleum Tool & Boring Co., of London.

W. R. Wade, formerly manager of the New York Zinc Co., was in New York last week. He is now living at 34 Lafayette Park, Lynn, Mass.

Frank M. Estes, general manager of the Dolores Esperanza corporation, Madera, Chihuahua, Mexico, was a visitor in New York during the past week.

Walter F. Pond, geologist, Missouri Geological Survey, Rolla, Mo., was in New York last week. He was on his way to spend a vacation in New England.

R. Johnstone, formerly with the United Comstock Mines Co., Virginia City, Nev., is now general manager for the Nevada Engineering & Supply Co., Reno, Nev.

Philip D. Wilson, formerly chief geologist for the Calumet & Arizona Mining Co., will sail from New York on Jan. 6 for Santiago, Chile, where he will represent the American Metals Co.

George H. Garrey, who has been absent on geological work in British Columbia, Mexico, and some of the Western states for more than a year, has just returned to his Philadelphia office.

Lloyd C. White, of Burch, Hershey & White, San Francisco, is designing a new rock-crushing plant for the Mountain Copper Co., Shasta County, Calif., to replace the one recently destroyed by fire.

Theodore P. Holt is returning to his home, 340 Valley View Ave., Whittier, Calif., for the holidays. He has been in Bolivia for several months supervising the installation of metallurgical equipment.

Robert D. Ferron, formerly of the engineering firm of Douglas, Lawrence & Co., has opened offices as a consulting mining engineer and metallurgist, at Casilla 206, Oruro, Bolivia, South America.

Harold and **Gideon Boerecke,** Philadelphia capitalists interested in the Minnie Moore mine, at Bradford, Idaho, recently inspected developments there, accompanied by **Oscar H. Hershey,** geologist and mining engineer.

James R. Evans, mining engineer, is expected in New York early in January. He is returning from Angola and the Belgian Congo, where he has spent the greater part of the last fourteen years engaged in professional work.

Lucien Eaton, superintendent of mines in the Ishpeming, Mich., district for the Cleveland-Cliffs Iron Co., has been granted a five-months' leave of absence. He will spend this time in looking over mining properties in Peru for an eastern interest.

Attorney General Keeling of Texas has gone to Washington, D. C., to assist **Land Commissioner Robinson** in pressing the claims of Texas citizens to oil rights in the Red River region, recently declared a part of Oklahoma by federal court decision.

Enoch Perkins

Enoch Perkins, formerly general superintendent of mines for the Replogle Steel and Empire Steel & Iron companies at Wharton, N. J., is now managing director of chrome mines in New Caledonia, with headquarters at Noumea, the capital of the colony.

G. F. Loughlin, of the Geological Staff of the U. S. Geological Survey, has returned from a visit to San Francisco and Salt Lake City, where he conferred with leaders in the mining industry in regard to some of the economic phases of the mining situation.

Arthur Wade, the American geologist now in the employ of the Australian Commonwealth Government reporting on oil possibilities in that country, is next to examine certain regions in New South Wales, and afterward Roma, in Queensland, as well as other parts of the latter state.

John Carter Anderson, consulting engineer for the Canario Copper Co., is returning to his home at Beverly Hills, Calif., after a prolonged stay at the properties of the company, at Nacozari, Sonora, Mexico, spent in geological study and in planning the expanding developments of the Canario company.

T. H. Palmer, representative of the firm of Beer, Sondheimer & Co., whose activities in the ore trade are carried on throughout Europe and America, has been on a visit to Tasmania, Australia. It is said that his company is considering the establishment of ore-treatment works on the west coast of Tasmania.

Frederick S. Mance has been appointed Under Secretary for Mines in New South Wales, Australia, in succession to R. H. Cambage, who has been retired because he has reached the age limit of sixty-five years. Mr. Mance, who is a native of New South Wales, entered the Mines Department of that state thirty-four years ago.

Gordon Links and **Jeremiah O'Rourke,** who have been connected with the McKinney Steel Co.'s mining department at Bessemer, Mich., have gone to Concheno, Chihuahua, Mexico, to work for the Concheno Mining Co., which company is controlled by the McKinney Steel Co. Mr. Links was mining captain at the Colby-Ironton mine and Mr. O'Rourke the mining engineer.

Harry F. Sinclair, chairman of the board of directors, Sinclair Consolidated Co., and party, consisting of **C. E. Crawley, George H. Talbot, Jr., J. W. Carnes, E. W. Isom, C. A. Bailey,** and **G. B. Winship,** all officials of the Consolidated or subsidiary companies, passed through Houston recently on their inspection trip of oil fields and refineries. At Houston they inspected the Sinclair refinery on the Houston ship channel.

F. G. Clapp, the American geologist who has been making investigations on behalf of C. E. Broue, of Sydney, into the oil lands of certain parts of Western Australia, has returned to Sydney after seven months' absence. In that time he traveled 5,000 miles and visited territory that has probably never before been entered by a white man. He is of the opinion, speaking generally, that the oil prospects in the areas examined are not encouraging.

J. Gray Buchannan, who is a member of the advisory committees of the British Department of Overseas Trade and Imperial Mineral Resources, is on a visit to Australia, and is spending three months in Hobart, Tasmania. Mr. Buchannan, referring to American prosperity, said Americans are "swimming in gold," and that "the artificial conditions under which they are living will finally suffocate them." It is his opinion that when the people of the United States learn that it is necessary for their own sake to put the gold into circulation the trade of the world will quickly improve.

Obituary

E. Michot, general manager of the Boleo Company, operating in Lower California, died on Dec. 15, according to a dispatch received in New York.

John B. Ingram, who developed the Smuggler-Union mine at Telluride, Colo., which he sold in 1887 to an English syndicate—died in Salt Lake City, Dec. 16, at the advanced age of eighty-one. Mr. Ingram came from Ouray, Colo. to Salt Lake City in 1889, and made that place his home, although he took no part in the mining industry of Utah. He was one of the oldest members of the Alta Club, of Salt Lake City.

Recent Technical Publications

Reviews, Abstracts, and References

Structural Metallography. By H. B. Pulsifer. The Chemical Publishing Co., Easton, Pa. Price $5.

This book is based on a study of the metals with a microscope; it is an "abundantly illustrated account of metal structures," designed as a text, with laboratory directions, for students. The scope of the book is indicated by the chapter headings: Metal Structures and Testing; Solidification of Metals; Smoothing and Etching Metal Surfaces; Photomicrography; Properties of Metals and Simple Structures; Pure Metals; the Iron-carbon Series; Iron and Steel Castings; Transformations and Treatments; Worked Metal; the Major Alloys.

Refractory Facts. Published by the Walsh Fire Clay Products Co., St. Louis, for free distribution.

Though the publishers call this a catalogue in a foreword, it is really more than that and contains much information of interest to the users of refractories. Missouri fire clay is traced through the various processes from mine to brick, with numerous illustrations and tables in connection with its commercial use.

Patents

Ball Mill — No. 1,517,538. Dec. 2, 1924. A. C. Daman, Denver. A ball mill mounted on a frame designed so that the mill may be tipped at any desired angle from the horizontal.

Pneumatic Sizer—Nos. 1,517,595-6-7. Dec. 2, 1924. A. H. Stebbins, Los Angeles. Designs for pneumatic sizers or separators.

No. 1,517,900. Dec. 2, 1924. R. M. Gay, Hanover Township, Morris County, N. J. Design for an air separator.

Liquid Oxygen—No. 1,517,294. Dec. 2, 1924. Ambrose Kowastch, Berlin-Charlottenburg, Germany. A receptacle for storing cartridges for saturation with liquid air. Patent No. 1,517,295, issued to the same applicant, covers a form of primer for liquid-air explosives.

Lead Refining—Reissue No. 15,960. Dec. 9, 1924. Henry Harris, London, England. This patent covers the apparatus used in the Harris process of lead refining recently introduced into the United States, embodying a container for the molten reagent and means for passing the molten lead through the reagent several times to remove impurities.

Thickener—No. 1,518,136. Dec. 9, 1924. J. V. N. Dorr, New Canaan, Conn., assignor to the Dorr Co., New York City. Control apparatus for thickeners, actuated by variations in density of the pulp.

Vibrating Screen — No. 1,518,236. Dec. 9, 1924. C. R. Walcott and W. J. Pike, Newaygo, Mich., assignors to M. F. Hatch, Newaygo, Mich. Design for a belt-driven vibrating screen.

No. 1,519,237. Dec. 16, 1924. N. E. Brown, Los Angeles, assignor to The Braun Corporation, Los Angeles. Design for an electrically vibrated screen.

Slag Treatment—No. 1,517,689. Dec. 2, 1924. H. V. Welsh, Los Angeles, assignor to International Precipitation Co., Los Angeles. Molten slag is brought in contact with a halidizing agent in an oxidizing atmosphere, so as to form volatile compounds with the metallic constituents of the slag, which are subsequently collected. The slag residue is leached to recover metallic values.

Flotation Machine — No. 1,518,010. Dec. 2, 1924. G. R. Simpson, Kingman, Ariz. Design for a pneumatic flotation cell.

Drilling Equipment—No. 1,517,312. Dec. 2, 1924. G. M. Nell, Denver, assignor to the Denver Rock Drill Manufacturing Co., Denver. A mounting for rock drills.

No. 1,517,470. Dec. 2, 1924. F. M. Slater, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. An air-feed lock for rock drills.

No. 1,517,497. Dec. 2, 1924. Jesse Ditson, Littleton, Colo., assignor to Ingersoll-Rand Co., Jersey City, N. J. A blow gun for drill sharpeners.

No. 1,517,512. Dec. 2, 1924. C. A. Hulquist, Los Angeles. Design for a hammer drill.

No. 1,518,250. Dec. 9, 1924. J. W. Campbell, Wendel, Pa. Design for a mine drilling machine.

No. 1,518,347. Dec. 9, 1924. J. M. Nelson, T. C. Moritz, and William Dilley, Denver. Design for a hammer drill.

No. 1,518,370. Dec. 9, 1924. M. E. Thomas, Stratford, Okla., assignor of one-fourth to J. L. Gray, Britton, Okla.; one-eighth each to G. C. Arnold and W. L. Allen, and one-fourth to Ida F. Hasley, Oklahoma City, Okla. Design for a well drill.

No. 1,518,384. Dec. 9, 1924. Abe B. Blaustein, Butte, Mont., assignor to Electrical Development Corporation, Butte. An electrically operated stoping drill.

No. 1,518,634. Dec. 9, 1924. D. K. Cason, Jr., Orange, Texas. A safety clutch for drill stems.

No. 1,519,512. Dec. 16, 1924. G. W. Schrock, Kellogg, Idaho. Design for a drill stem.

No. 1,519,981. Dec. 16, 1924. Chester Mott, Denver, assignor to Sullivan Machinery Co. A supporting means for rock drills.

Chloride Volatilization — No. 1,518,375. Dec. 9, 1924. S. J. Vermaes, Delft, and L. L. J. van Lijnden, The Hague, The Netherlands. Metals are extracted from their volatile chlorine compounds by bringing a gas current containing vapors of the chlorine compounds into contact with a solid alkaline substance and a reducing agent at a high temperature. Patent No. 1,518,376 issued to the same applicants covers preheating the ore in an oxidizing atmosphere, transporting the ore to a place where it is mixed with a chloridizing agent, agitating the mixture, and removing the chloride vapors by a slow current of non-reducing gas.

Converter Tuyère — No. 1,517,972. Dec. 2, 1924. P. A. Faust, Miami, Ariz. A converter tuyère with means for preventing the escape of fluid when punching.

Electrolytic Copper Refining — No. 1,518,609. Dec. 9, 1924. F. J. Sibol, Perth Amboy, N. J., assignor to Raritan Copper Works. An apparatus to facilitate the removal of starting-sheet deposits from their receiving blanks.

Matte Smelting—No. 1,518,626. Dec. 9, 1924. C. W. Whitley, Salt Lake City, Utah, assignor to American Smelting & Refining Co., New York City. Lead is removed from copper-lead matte by roasting the matte to reduce the sulphur content below the copper content of the charge, adding sufficient siliceous material to slag the iron, and smelting with a reducing fuel.

Concentrating Copper Ore—No. 1,518,828. Dec. 9, 1924. E. B. Thornhill, and H. G. S. Anderson, Hurley, N. M., assignors to Thornhill-Anderson Co., Muskogee, Okla. Ores containing oxidized copper minerals are ground in the presence of iron and water to form a pulp containing finely divided ore and finely divided metallic iron. Acid is then added to dissolve the oxidized copper, which is precipitated by the iron. The pulp is then neutralized and subjected to flotation to concentrate the precipitated copper. Patent No. 1,518,829 issued to the same applicants, covers the recovery of copper from both oxidized and sulphide ores by treating the ground pulp with acid to dissolve the oxidized copper, precipitating the dissolved copper in metallic form by a reducing agent, neutralizing the pulp by an alkaline earth carbonate, and then subjecting the pulp to flotation to recover the precipitated copper together with the sulphide copper in the ore.

Classifier — No. 1,519,019. Dec. 9, 1924. S. H. Boylan, Joplin, Mo., assignor to The Ore Reclamation Co., Baxter Springs, Kan. Design for a cone separator and rake classifier for separating fine from coarse material in an ore pulp and dewatering.

Petroleum—No. 1,519,042. Dec. 9, 1924. G. A. Osborne, El Dorado, Ark. A sand trap for oil wells.

No. 1,519,445. Dec. 16, 1924. E. D. Finney, Ranger, Tex. An oil-well tool connection.

Cyanide Process—No. 1,519,396. Dec. 16, 1924. F. M. Darrow, Jackson, Calif. Refractory gold- and silver-bearing tailings are treated with a solution of the sodium or potassium salts of the organic acids of the higher members of the series $C_nH_{2n}O_2$, and then subjected to the cyanide process.

Precious Metal Recovery—No. 1,519,464. Dec. 16, 1924. T. R. McNerthney, Tacoma, Wash. The patent covers an apparatus for separating and collecting precious metals from earth, in which are used an X-Ray tube, an electric magnet, and "mercurized" plates.

Aluminum Extraction—No. 1,519,648. Dec. 16, 1924. G. L. Williams, Detroit, assignor to Detroit Aero Metals Co., Detroit. Aluminum ore is heated in the presence of chlorine to produce aluminum chloride, which is then electrolyzed to produce metallic aluminum and chlorine gas.

New Machinery and Inventions

A New CO_2 Indicator for the Steam Plant

Amount of Fuel Wasted Up the Chimney May Be Readily Determined by This Simple Instrument

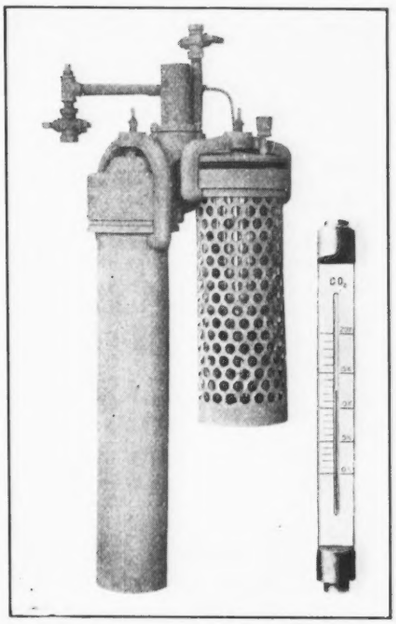
A NEW boiler room instrument, known as the "Apex" pneumatic CO_2 indicator, has been developed primarily to meet the demand from the smaller steam power and heating plants for a simple and inexpensive instrument for measuring the fuel wasted up the chimney. The manufacturer claims that this indicator will operate accurately with about five minutes' attention once a week.

The "Apex" CO_2 indicator consists of two principal parts—namely, the actuating device, known as the CO_2 meter, and the gage proper, known as the Type Z indicator. The flue gas flows through the CO_2 meter continuously, developing a changing pneumatic pressure within it, the magnitude of the pneumatic changes depending upon the percentage of CO_2 present in the gas. The CO_2 is absorbed in a dry cartridge placed in the meter. The absorption of CO_2 causes a shrinkage of the gas flowing through the meter and hence a reduction in the pneumatic pressure. Any given percentage of CO_2 in the gas will produce a definite pre-determined pneumatic pressure, which is employed for operating the Type Z indicator. The indicator consists simply of a manometer containing a glass tube filled with colored liquid, which changes its level according to the pneumatic pressure applied to it. A scale located beside the indicating manometer is graduated in percentages of CO_2.

A simple steam or water aspirator is used to draw the gas from the boiler, through the meter. A large volume of gas is bypassed around the meter at the same time, under the action of the aspirator, which results in speedy response to change in furnace conditions.

The suction from the aspirator is maintained constant, by a simple hydrostatic regulator, regardless of possible aspirator pulsations. This regulator is simply a closed vessel filled with water, the space above which is connected with the aspirator. An air inlet pipe extends into the water to a point near the bottom of the vessel and is so arranged that air may be drawn in through the bottom of this pipe and caused to bubble up through the water under the effect of the suction above the water. This bubbling air automatically prevents the suction from increasing beyond the point for which the regulator is designed. The water level in this regulator is kept constant by a fixed overflow. A similar hydrostatic regulator, placed in the inlet bypass, previously mentioned, likewise acts to hold the suction on the inlet side of the machine constant, irrespective of variations in the chimney draft.

In entering the CO_2 meter, under an unvarying inlet suction, the gas first passes through a constricted passage, then through the dry absorbent cartridge and then emerges through a second constricted passage, escaping under the constant exhaust suction, previously mentioned. Each of the two constrictions consists of a tube of definite length and bore, which acts as a fixed resistance to the flow of gas. There is no resistance in the absorbent cartridge, the gas flowing freely through it at all times. These cartridges are each guaranteed for a life of 1,200 per cent hours and are easily renewable when necessary. The pneumatic pressure existing between the two constrictions is at all times below atmospheric pressure and as the percentage of CO_2 increases the pneumatic pressure decreases correspondingly over a wide range because of gas shrinkage due to absorption. The Type Z indicator is connected to the absorption chamber by means of small bore tubing and it instantly responds to all fluctuations in the pneumatic pressure.



The CO_2 meter (left)
This actuates the Type Z indicator. The chamber on the left contains the dry absorbent cartridge and the constricted passage for the overflowing gas. In the center is the inlet gas regulator.

The Type Z indicator (right)
This is connected to the absorption chamber by means of small bore tubing and instantly responds to all fluctuations in the pneumatic pressure.

A point of particular interest is that at no time is the gas hermetically sealed in the CO_2 meter. This fact makes it always possible for the indicator to point to the percentage of CO_2 existing in the meter at the moment.

Because of the simple pneumatic principle employed, the design is entirely devoid of mechanically operated parts, special glassware and rubber tubing. Referring to the illustration of the CO_2 meter, the chamber on the left contains the dry absorbent cartridge and the constricted passage for the overflowing gas. The vessel on the right is the inlet gas regulator. The gas from the boiler enters through the vertical pipe at the top of the instrument and flows into the small chamber adjoining it, which contains the inlet constricted passage. The horizontal pipe extending to the left is the outlet which conducts the gas to the outlet and aspirator. The latter two parts are not illustrated here.

The "Pyro-porus" filter is used, which is placed on the end of the sampling line within the boiler setting and completely excludes soot and ash. Another important claim made for the instrument is that sulphuric acid fog is eliminated from the gas and the gas is completely dried, which prevents corrosion of the sampling line.

The indicator is being made by the Uehling Instrument Co., of Paterson, N. J. A corresponding instrument of the recording type is also being introduced by the same company. Both types are illustrated in Uehling Bulletin No. 118.

Trade Catalogs

Balanced Rod Mill—Joshua Hendy Iron Works Co. has issued Bulletin No. 136, describing the Forrester-Rexman balanced rod mill. This is of the multiple-compartment type, for which not fewer than twenty-five advantages are claimed over a standard 1,050-lb. stamp battery of the same crushing capacity. A supplementary sheet gives details of a test on a 48 x 30-in. mill of this type at the Keyes mine of the Kern River Mining Co., on an ore containing about 25 per cent decomposed granite and 75 per cent quartz of the usual hardness. The mill was equipped with a No. 3 needle-slot discharge screen, No. 26 gage, 0.0415 in. opening, equal to 25 mesh. The capacity proved to be 4,200 lb. per hour, or 50.4 tons per day, with a power requirement of 6 hp., or a production of 8.4 tons per horsepower.

Screening analyses of feed and discharge were as follows:

				Feed, Per Cent	Discharge, Per Cent
Minus 2 in				4.76	.....
Through	2 in. on	1½ in.		14.26	.....
Through	1½ in. on	1 in.		6.49	.....
Through	1 in. on	½ in.		12.87	.....
Through	½ in. on	¼ in.		11.51	.....
Through	¼ in. on	8 mesh		27.01	.....
Through	8 mesh on	20 mesh		9.85	0.31
Through	20 mesh on	30 mesh		.....	18.84
Through	30 mesh on	40 mesh		6.76	19.31
Through	40 mesh on	60 mesh		2.61	25.67
Through	60 mesh on	80 mesh		0.29	2.51
Through	80 mesh on	100 mesh		0.84	9.74
Through	100 mesh on	150 mesh		1.06	6.02
Through	150 mesh on	200 mesh		0.68	4.92
Through	200 mesh			1.01	12.65

The ore is being treated by amalgamation and concentration.

Gasoline Locomotives—The Vulcan Iron Works, Wilkes-Barre, Pa., has just issued a new 20-page bulletin, No. 101, devoted exclusively to the Vulcan worm-gear drive gasoline locomotive. In addition to a complete description there are illustrations showing various parts of the locomotive. A four-page leaflet is inclosed, giving the rated hauling capacities of all the popular sizes from three tons to twenty-five tons. This company also builds the Vulcan steam locomotive. Bulletin 101 will be mailed free to prospective users of gasoline locomotives.

The Market Report

Daily Prices of Metals

Dec.	Copper N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
18	14.375	55.125	55.625	9.45	9.25	7.425@7.45
19	14.375	56.00	56.50	9.45	9.25	7.475
20	14.375@14.50	56.375	56.875	9.45	9.25	7.50
22	14.45 @14.50	56.625	57.125	9.45	9.25	7.55@7.575
23	14.50@14.625	56.875	57.375	9.60	9.35	7.65@7.675
24	14.60	57.25	57.75	9.60	9.35	7.65@7.70
Av.	14.471	56.375	56.875	9.50	9.283	7.552

*These prices correspond to the following quotations for copper delivered: Dec. 18th and 19th, 14.625c.; 20th, 14.625@14.75c.; 22d, 14.70@14.75c.; 23d, 14.75@14.875c.; 24th, 14.85c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electro-lytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
18	65 1/2	66 5/8	70	259 1/2	263	42 1/4	39 1/2	37 1/4	36 15/16
19	65 3/4	66 7/8	70	261 3/4	264 3/4	42 5/8	39 3/4	37 1/4	37
22	66 1/2	67 1/2	70 3/4	265 1/2	268 1/2	42 5/8	40 1/8	37 7/8	37 7/16
23	66 7/8	67 7/8	71 1/4	267 1/2	271	43 1/4	40 7/8	38 1/2	37 15/16
24	66 5/8	67 3/4	71 3/4	268 3/4	272	43 5/8	41 3/8	38 5/8	38 1/4

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
18	4.69	67 7/8	32 7/16	88s 10d	22	4.70 5/8	67 3/4	32 1/4	88s 5d
19	4. 70 1/8	67 3/4	32 5/16	88s 7d	23	4.69 7/8	67 1/4	32 3/16	88s 6d
20	4 70 1/2	67 3/4	32 5/16	... ...	24	4.69 1/2	66 7/8	32 1/16	... ..

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Prices Advance Further in Quieter Market

New York, Dec. 24, 1924—The approaching holidays had a perceptible effect on business in the non-ferrous metal market during the last few days, but there was no scaling down of prices; on the other hand, prices of all the metals are now higher than a week ago. Strength in the London market, which advanced daily, was chiefly responsible, though producers would be in no mood to cut prices after their recent heavy sales, even though foreign reports were temporarily unfavorable. Producers' stocks of all metals are almost non-existent. The most spectacular advance of the week was in antimony, which advanced over 2c. per lb.

Copper Approaches 15c.

For a long time producers have looked forward to a 15c. copper market, at which level most all of them can make money, and today the goal is virtually reached; in fact, copper has already sold for 15c. delivered in the Middle West. Copper sold on Tuesday at 14⅞c. in the East, and today that price is generally quoted by all sellers for first-quarter delivery, though small tonnages of December copper might be picked up for shipment near New York at 14⅜c. still. The volume of business for the week has been satisfactory, though not nearly so large as was reported last week. Many producers could have sold much more had they had the metal available. Some refineries are shipping copper hot from the furnaces and have the equivalent of two months' forward production sold.

Foreign demand has been good all week, though prices have held consumers in check somewhat. The market in Europe yesterday and today has been 14⅞@15c., c.i.f.

Official Lead Price Advanced Twice

The official contract price of the American Smelting & Refining Co. for lead in New York was advanced from 9.25 to 9.35c. on Thursday, Dec. 18, and a further advance to 9.50c. was made on Tuesday, Dec. 23.

The so-called outside market continues substantially above the Smelting company's quotation, though little business is being done at these premium prices. Most of these sales have been on the basis of 10c. New York, and there has been little disposition to quote higher prices than this, even in the last two days, after the second advance in the contract price. The leading producer in the Middle West continues to quote ¼c. under the official New York price, though having only limited tonnages available for regular customers. However, the tonnage thus released is somewhat greater than it was, and with consumers less willing to pay the high prices quoted by others, the level set by this producer is having more influence in stabilizing the market below the A. S. & R. New York price. In the last two days nominal quotations of 9.90c., St. Louis, have been made, but the business done at this level is extremely small.

Foreign demand has been excellent all week, chiefly to Europe, with prices increasing almost daily. Domestic consumers, while willing to take all the lead they can get, have possibly not been quite so insistent in their demands in the last few days. There is little incentive to buy lead except from hand to mouth at current prices.

Zinc Continues Upward Trend

Zinc sales to domestic consumers have been in fair volume during the week, but to some producers the foreign market has been more attractive. Germany has been in the market for particularly large tonnages, and the prices realized on this export business have been slightly above domestic levels. The increase in Prime Western quotations has again influenced the level of high-grade zinc, which is now being marketed for 8¾c. in the east.

Tin in Moderate Demand

Consumers have recently bought near-by tin in moderate amounts at any recessions in price, but none have occurred in the last week. The absence of any stocks in the Far East has probably had an influence in the advancing price. Very little buying of March tin has been done; prices on such forward metal are about ⅛c. higher than for spot. Arrivals of tin to and including Dec. 23 were 3,780 long tons.

Foreign Exchange Quiet

Sterling advanced above $4.70 during the week, but the foreign exchange market as a whole has been quiet and practically unchanged. On Tuesday Dec. 23 closing cable quotations on francs were 5.385c.; lire 4.2725c.; and marks 23.81c. Canadian dollars ⅛ per cent discount.

Silver Lower

The London and New York market has declined during the week because of the absence of buyers owing to the approach of the Christmas holidays.

Mexican Dollars; Dec. 18th, 52⅜c.; 19th, 52¼c.; 20th, 52¼c.; 22nd, 52¼c.; 23rd, 51⅜c.; 24th, 51½c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 14¼@16c.
Cookson's "C" grade, 17⅞c.
Chinese needle, lump, nominal, 10c.
Standard powdered needle, 200 mesh, 11½c.
White oxide, Chinese, 99 per cent Sb_2O_3, 13@14c.
Consumers active, and only small amounts of metal available. Market making spectacular advances.

Bismuth—$1.25@$1.30 per lb. London, 5s. Price reduced Dec. 23.
Consumption of bismuth has not been heavy enough to absorb the quantities offered in the past few months. Reduction was made to move existing stocks.

Cadmium—60c. per lb. London, 2s. 2d.@2s. 6d.

Iridium—$325 per oz.

Nickel—29@30c. per lb. for 99 per cent virgin metal. Electrolytic, 33c.; London, £160 per long ton.

Palladium—$79@$83 per oz. Crude, $60@$65.

Platinum—$117 per oz. for refined. Crude, $111.

Quicksilver — $74 per 75-lb. flask. San Francisco wires $72.65. Quiet. London, £12⅜.

The prices of **Cobalt, Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Osmiridium, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten,** and **Zirconium** are unchanged from the prices given in the Dec. 6 issue.

Metallic Ores

Tungsten Ore—Per unit, N. Y.:
Chinese wolframite, $8.85@$9.
High-grade Western scheelite, $9@$9.25.
Western producers holding tungsten ore at higher prices while eastern market has also become stiffer.

Chrome, Iron Ore, Galena and **Pyrite Radio Crystals, Manganese, Molybdenum, Tantalum,** and **Vanadium Ores** are unchanged from Dec. 6 quotations.

Zinc and Lead Ores Both Higher

Joplin, Mo., Dec. 20, 1924

Zinc Blende	Per ton
High	$52.80
Premium, basis 60 per cent zinc	$55.00@$56.00
Prime Western, 60 per cent zinc	$52.00@$54.00
Fines and slimes, 60 per cent zinc	$51.00@$49.00
Average settling price, all	$48.25
Lead Ore	
High	$130.60
Basis 80 per cent lead	$130.00
Average settling price, all	$122.63

Shipment for the week: Blende, 15,560; lead, 2,127 tons. Value, all ores the week, $1,011,700.

Rain and sleet Wednesday and Thursday covered the entire mining district with three inches of ice, accompanied by zero temperatures, freezing pond water and incapacitating numerous mills. Very little ore was produced yesterday or today, and loading ore was stopped where haulage was necessary. As a consequence sellers, having little visible zinc ore for sale, were reluctant to contract unproduced ore. Similar considerations prevailed in the lead market.

Platteville, Wis., Dec. 20, 1924

Zinc	Per ton
Blende, basis 60 per cent zinc	$52.00
Lead	
Lead, basis 80 per cent lead	$125.00

Shipments for the week: Blende, 768 tons; lead, 40 tons. Shipments for the year: Blende, 31,542; lead, 1,546 tons. Shipments for the week to separating plants, 1,203 tons blende.

Non-Metallic Minerals

Barytes—f.o.b. Kings Creek, S.C.
Crude, $6.50@$8 per gross ton.
Ground, off color, $13 per ton.
White, bleached, $17 per ton.
Water ground, 300 mesh, bags included, $21 per ton, Charlotte, N. C.

Bauxite — American, f.o.b. shipping point per gross ton:
Crushed and dried, $5.50@$8.75.
Pulverized and dried, $14.
Calcined, crushed, $19@$20.
Foreign per metric ton, c.i.f.:
French red, $5@$7.
Adriatic, low SiO_2, $5@$7.50.

Mica—Madagascar amber, dark, free from iron, per lb., f.o.b. New York:

No. 1	$2.75	No. 4	$0.75
No. 2	2.25	No. 5	.50
No. 3	1.35	No. 6	.30

Other mica prices in Dec. 6 issue.

Amblygonite, Asbestos, Barytes, Beryl, Borax, Celestite, Chalk, China Clay, Corundum, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and **Zircon** are unchanged from Dec. 6 prices.

Mineral Products

Arsenious Oxide (white arsenic)—6½@6¾c. per lb. Very little arsenic has been sold recently, but producers feel that nothing would be gained by reducing prices further.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and **Zinc Oxide** are unchanged from Dec. 6 prices.

Ferro-Alloys

Ferromanganese—Domestic, German, and English, $110 per gross ton, f.o.b. works, or duty paid at seaport.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and **Ferrovanadium** are unchanged from the prices given in the Dec. 6 issue.

Metal Products

Rolled Copper — Sheets, 22⅜c. base; wire, 16⅞c.

Nickel Silver—18 per cent Grade A sheets, 29c. per lb.

Yellow Metal — Rods, 17⅛c.; sheets, 20⅛c. per lb.

Lead Sheets—Full, 13c.; cut, 13¼c. per lb.

Zinc Sheets—10⅜c. per lb.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from Dec. 6 prices.

Steel Market Firm

Pittsburgh, Dec. 23, 1924

The outstanding feature of the steel market is the fact that it has not yielded in activity on account of the season of year. The total turnover in the market has probably decreased somewhat in the last week or two, but if so this is a reflection of there having previously been heavier buying, to take advantage of prices which have since disappeared. In bars, shapes and plates mills state there are prospects of further advances and that they wish to keep the market from advancing with such speed as to menace the future.

Mill operations, instead of tapering off, have increased farther and now average fully 80 per cent, the average of the last two years having been about 74 per cent and of the six years since the war about 66 per cent. Still heavier operations are predicted for January.

Prices of $35.50 for billets and slabs and $37 for sheet bars, ruling for some time, have suddenly disappeared, and there is question what would have to be paid, prices of $37 and $38 respectively being mentioned as likely to be bid.

Pig Iron—Though buying demand has been relatively light, merchant furnaces have had no difficulty in getting the market up about a dollar a ton, to cover the increased cost of coke due to the recent wage advance in the Connellsville region, the market now being at $22.50@$23 for bessemer, $21.50@$22 for basic, and $22@$23 for foundry, f.o.b. Valley furnaces.

Connellsville Coke — Present asking prices of $4.25@$4.50 for spot furnace coke, and $4.50@$5 for spot foundry are based on the recent wage advance, but find little reflection in actual purchases, buying demand being light.

Company Reports

Mount Lyell Mining & Railway Co., Ltd.

Mount Lyell, Tasmania

A report of the operations of the Mount Lyell Mining & Railway Co. for the fiscal year ended Sept. 30, 1924, states that the total quantity of ore won was 125,613 tons, compared with 133,680 for the preceding year.

At the North Mount Lyell mine, the ore mined was 112,278 tons, of which 4,189 was sent direct to the converting plant and 108,089 to the concentrating mill. The average assay value of the whole of the ore was 5.96 per cent copper, 1.05 oz. silver, and 0.018 oz. gold.

Development has for some years been restricted to a minimum. After due consideration, it has been decided to raise the Mount Lyell blocks shaft through to the surface, and make connections with existing North Mount Lyell workings at various levels. This shaft is well situated not only for the development, but also for the subsequent economical working of the North Mount Lyell orebodies at the lower levels. These extensions will take about eighteen months to complete.

At the Mount Lyell Mine the ore mined was 13,079 tons, of which 5,524 were won from the open-cut, and 7,555 from the underground workings at No. 5 level.

The ore reserves of the North Mount Lyell mine as at Sept. 30, 1924, are estimated as follows:

	Average Assay		
Tons Dry	Copper, Per Cent	Silver, Oz.	Gold, Oz.
907,768	6.0	1.33	0.015

The blister copper produced amounted to 7,097 tons, compared with 5,478 tons for the year ended Sept. 30, 1923. The contents were:

	Year Ended Sept. 30, 1924	Year Ended Sept. 30, 1923	Year Ended Sept. 30, 1922
Copper, tons	7,033	5,430	6,019
Silver, oz.	151,296	109,812	137,392
Gold, oz.	2,299	1,808	2,761

Of the output of copper for the year, it is estimated that 867 tons are attributable to ore won in the previous year. During the year the concentration plant treated 107,815 tons of ore from the North Mount Lyell mine, and produced 34,517 tons of concentrates.

Further improvements in the various sections of the crushing and treatment plant have been made. These have achieved expectations so far as reduction in costs is concerned, and in respect of recoveries have exceeded anticipations. The total recovery of copper by the combined processes now exceeds the recovery formerly obtained as the result of direct smelting.

The working account shows a profit of £191,397 2s. 9d. After deducting £6,245 0s. 7d. for prospecting, £29,415 12s. 9d. for depreciation of mine plant, and £10,658 3s. 9d. for taxation, the net profit from all sources amounts to £151,182 1s. 8d., compared with £151,002 17s. 8d. for the previous year.

The company's liquid assets at Sept. 30, 1924, apart from shares in other companies, show a surplus of £805,014 8s. 4d. over liabilities, made up as follows:

	£	s.	d.
Metals on hand and in transit, and middle products on hand	191,338	0	0
Sundry debtors	259,869	11	9
Credit balances at banks	124,090	9	10
Commonwealth bonds and bank deposits	159,967	7	11
Stocks on hand	342,515	15	3
	£1,077,781	4	9
Less			
Sundry creditors	£135,660 15 1		
Drafts and advances against shipments	4,555 1 4		
London transfers	2,551 0 0		
Capital expenditure authorized	130,000 0 0		
	272,766	16	5
	£805,014	8	4

The substantial improvement in the above figures is due mainly to the realization of share holdings.

A satisfactory year was experienced at Yarraville and Fremantle chemical works. Owing to the increasing demand for the company's products, substantial additions are being made to both works. A high state of efficiency is maintained, and no opportunity is neglected in the reorganization of the works and the introduction of the most modern methods, to lower costs and to produce the best superphosphate and other fertilizers on the market.

Belgian Zinc Production

The following table gives the production of Belgian zinc smelters by months since 1921:

Tons of 2,240 Lb.

	1924	1923	1922	1921
January	13,940	10,650	8,250	8,310
February	13,300	11,340	7,750	6,530
March	14,020	12,990	8,950	4,640
April	12,430	12,610	8,490	4,320
May	13,250	12,240	8,830	4,360
June	12,700	12,010	8,310	4,370
July	13,000	11,960	8,960	4,950
August	13,280	11,975	9,640	5,000
September	13,510	11,950	9,870	4,990
October	14,250	12,670	11,007	5,460
November	13,750	12,890	11,250	6,170
December	.....	13,790	11,130	7,370
Totals	.....	147,075	112,437	66,470

December Mining Dividends Highest for the Year

The following dividends were paid by mining and metallurgical companies during December:

Companies in the United States	Situation	Per Share	Total
American Metal	U. S. and Mexico	$0.75 Q	$443,657
American Metal, pfd	U. S. and Mexico	1.75 Q	87,500
American Smelting & Refining, pfd.	U. S. and Mexico	1.75 Q	875,000
Bunker Hill & Sullivan, l,z	Idaho	1.00	327,000
Butte Copper & Zinc, z,l,s	Mont.	.50 I	300,000
California Rand Silver	Calif.	.01	12,800
Calumet & Arizona, c	Ariz.	.50 Q	321,264
Eagle-Picher Lead, l,z	Various	.20 X	200,000
Federal Mining & Smelting, pfd., s,l	Idaho	1.75 Q	210,000
Golden Cycle Mining & Red	Colo.	.03 I	45,000
Great Northern Iron Ore	Minn.	2.00 I	3,000,000
Hecla Mining, s,l	Idaho	.25 Q	250,000
Homestake Mining, g	S. D.	.50 M	125,580
Inland Steel	Minn.	.625 Q	629,379
Mother Lode Coalition, c	Alaska	.375 SA	937,500
National Lead	Various	2.00 Q	413,108
National Lead, pfd	Various	1.75 Q	426,433
Ohio Copper	Utah	.05 F	111,281
Park City Mining & Smelting, s,l,z	Utah	.15 I	131,400
St. Joseph Lead	Mo.	.50 Q	774,690
Sloss-Sheffield Steel & Iron	Ala.	1.50 Q	150,000
Texas Gulf Sulphur	Texas	2.25 QY	1,428,750
Tintic Standard, s,l,c	Utah	.20 Q	229,883
U. S. Steel	Various	1.75 Q	8,895,294
United Verde Copper	Ariz.	2.00 Q	600,000
Utah Copper	Utah	1.00 Q	1,624,490
Yellow Pine, s,l,z	Nev.	.04 I	40,000
Companies in other countries:			
Chile Copper	Chile	.625 Q	2,375,000
Hollinger Consolidated Gold	Ont.	.10 Z	492,000
Lake Shore, g	Ont.	.10 QW	200,000
Lucky Tiger-Combination, s,c,g	Sonora	.16	114,454
McIntyre-Porcupine, g	Ont.	.25 Q	199,500
Mexico Mines of El Oro, g,s	Mexico	5 sh.	£52,500
N. Y. & Honduras Rosario, g,s	Honduras	.50 X	$100,000
Cia. Minera de Peñoles, l,s	Mexico	1.50 F	450,000
St. John del Rey, g	Brazil	9 d.	£13,657
St. John del Rey, 10% pfd., g	Brazil	1 sh.	10,000
Wright-Hargreaves, g	Ont.	.05 QV	$137,500
Total			$26,668,465

Q, quarterly; I, irregularly; X, extra; M, monthly; SA, semi-annually; F, initial dividend; Y, includes 50c. per share extra; Z, regular 5c. dividend paid on Dec. 1 and 31; W, includes 5c. extra; V, includes 2½c. extra; z, zinc; l, lead; s, silver; c, copper; g, gold.

December is a favorite month for paying extra dividends, and several companies declared extras. Two companies, Ohio Copper and Peñoles, paid their first dividends. The total paid for the month was about $6,000,000 greater than was paid in September, for the preceding quarter, and more than $1,000,000 greater than was paid in December of last year. Total dividends paid by mining companies with headquarters in North America amounted to $176,644,023 for the year 1924. Additional amounts were paid by companies of which we have no record, including those privately owned.

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Prices of mine materials and supplies continue to rise. Since last month there have been advances in steel structurals and sheets, railroad spikes, lumber, linseed oil, red and white lead and litharge. A few minor declines were recorded, however, mainly in c.-i. pipe, clay products and rope. The cost trend has been definitely but not sharply upward since November 6.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2.70	$3.90	$3.80	$3.95	$3.89
Black No. 28	3.60	4.65	4.50	5.00	4.60
Galvanized No. 28	4.75	5.65	5.50	5.90	5.60

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00
Standard openhearth rails	43.00	43.00	43.00	43.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$2.80	$3.15	$2.90	$3.75	$4.35	$2.80
Track bolts	3.75@4.00	4.00	3.90	4.65	5.85	4.00
Standard section angle bars	2.75	2.75	2.75	3.40	4.00	2.85

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$2.00@2.10	$1.80@2.00	$3.34	$4.15	$3.25	$3.10	$3.00
Channel, 3 to 15 in.	2.00@2.10	1.80@2.00	3.34	4.15	3.25	3.10	3.00
Angles, 3 to 6 in., ¼ in. thick	2.00@2.10	1.80@2.00	3.34	4.15	3.25	3.10	3.00
Tees, 3 in. and larger	2.00@2.10	1.80@2.00	3.34	4.15	3.30	3.10	3.05
Plates	1.85@1.90	1.60@1.90	3.34	4.15	3.25	3.10	3.00

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Cast steel round strand rope	20%
Galvanized steel rigging and guy rope	7½%
Round strand iron and iron tiller	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Galvanized iron rigging and guy rope	+12½%

	New York	Cleveland	Chicago
Drill Rod (from list)	60%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Iron Inches	Iron Black	Iron Galv.
BUTT WELD	⅛ to 3	62	50½	⅛ to 1¼	30	13
LAP WELD	2½ to 6	59	47½	3 to 6	28	13

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	44%	53%	46%

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over	$55.60@56.60	$62.10@63.60	$40.00	$47.20@48.20	$48.60	$55.00

NUTS—Semi-finished, ½x½-in., 2c. each. Discount 70% for 9/16-in. and smaller; 65% for ⅝-in. and larger. Case hardened, 6c. each, less 50%.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.1162	$0.1179	$0.089	$0.125	$0.072	$0.108	.....
6x12x12	.1743	.1769	.114	.....	.097	.156	$0.2388*
8x12x12	.2179	.2211	.163	.215	.132	.244	.2956†

* 10x12x12; † 12x12x12.

MACHINE BOLTS—½x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 45%.

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers at yards in San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$28.00	$29.00	$30.00	$33.00
3x6 and 8	28.00	29.00	30.00	33.00
4x4-6 and 8	28.00	29.00	30.00	33.00

Wholesale prices to dealers of long leaf yellow pine. To contractors in New York City, delivered from lighters or cars to job, $5 additional.

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$41.00	$42.00	$.....	$.....
3x10 to 10x10	47.00	48.00	.....	.....
3x12 to 12x12	53.00	54.00	.....	.....

Other Cities	8 x8-In. x 20 Ft. and Under Pine	Fir*	Hemlock	Spruce	12 x 12-In. 20 Ft. and Under Pine	Fir*
Boston	$56.00	$54.00†	$50.00	$50.00	$66.00	$65.00†
Cincinnati	40.00	74.00	74.00	88.00	44.00	78.00
Denver	.....	35.75	35.75	.....	.....	36.75
Minneapolis	41.00	39.75	39.00	.....	44.10	39.75
Kansas City	39.50	.....	.....	.....	48.50	.....
Birmingham	32.00	.....	.....	.....	35.00	.....

* Douglas fir. † Prime.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.75	$3.25	$4.20	$4.55	$3.14	$4.95
Cut	2.90	....	5.25	....	3.39	5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.55@2.65
Chicago, f.o.b.	2.20	2.20	2.10
Cleveland, f.o.b.	2.39	2.39	2.41

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	280-lb. net Common
New York	$18.20	$12.@13.10	$3.75	$2.50@$3.00
San Francisco	22.00	16.00	....	(180-lb. net) 1.60

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$1.17	$0.95	$1.10	$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Current	Dry 1 Yr. Ago	In Oil Current	In Oil 1 Yr. Ago
Red	15.75	14.00	17.25	15.50
White	15.75	14.00	15.75	14.00

HOSE—Quotations at New York warehouses:

Fire Protection 50-Ft. Lengths
Underwriters' 2½-in. coupled, single jacket ..... 56c per ft.

Air—Best Grade
½-in., per ft. ..... 3 ply $0.36 4 ply $0.44½

Steam—Discounts from List
First grade ..... 30–5% Second grade ..... 40–5% Third grade ... 50%

RUBBER BELTING—List price 6-in., 6 ply, $1.83 per lin.ft. for rubber transmission belting.
Best grade ..... 50% Second grade 50 10%

LEATHER BELTING—List price, 24c. per lin.ft. per inch of width for single ply at New York warehouses:

Grade	Discount from list
Medium	40–2½%
Heavy	30–5%

RAWHIDE LACING—For cut, best grade, 45–5%, 2nd grade, 55%. For laces in sides, best, 41c. per sq.ft.; 2nd, 37c. Semi-tanned: cut, 45–5%; sides, 41c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE—Per lb., ¼-in. and larger, 1,200-ft. coils.

Atlanta	$0.19	New Orleans	$0.21½
New York	18½	Seattle	.17
Chicago		San Francisco	.21

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Minneapolis	.1917	.2123
Denver	.2025	.2275
Seattle	.165	.19
Cincinnati	.22	.245
New Orleans	.235	.29
San Francisco	.1625	.1925

FLOTATION OIL—
Pine tar, 50 gal. bbl., gross weight 500 lb., f.o.b. New York, carload lots, per gal. $0.30

CHEMICALS—

Zinc dust, 550 lb. casks, f.o.b. Palmerton, Pa., per lb.	$0.08½
Litharge, f.o.b. New York kegs, per 100 lb.	15.50
Sodium cyanide, 220 lb. single case lots, f.o.b. New York, per lb.	.19@.22

Mining Stocks

Week Ended December 20, 1924

Stock	Exch.	High	Low	Last	Last Div.
COPPER					
Alaska-Br. Col.	N. Y. Curb	...	...	*6	...
Anaconda	New York	43	41½	42½	De.15, Ja.21, Q 0.75
Arcadian Consol.	Boston	1⅜	1⅛	1⅜	...
Ariz. Com'l.	Boston	11½	11	11¼	Jy.19, Jy.31 0.50
Calaveras	N. Y. Curb	...	...	2	...
Calumet & Arizona	Boston	*53½	*52	*53	De.5, De.22 Q 0.50
Calumet & Hecla	Boston	16⅞	16¼	16½	My. 31, Jn. 16 0.50
Canario Copper	N. Y. Curb	4¼	4	4⅛	...
Cerro de Pasco	New York	52	50¼	51⅛	Oc. 23, No. 1 1.00
Chile Copper	New York	34⅞	34	34⅝	De.3, De.29, Q 0.62½
Chino	New York	26¼	26	26½	Sept., 1920 0.37½
Con. Coppermines	N. Y. Curb	3	2½	2⅞	...
Copper Range	Boston	28	26	28	May, 1923 1.00
Crystal Copper	Boston Curb	*57	*54	*56	...
Davis-Daly	Boston	*45	*40	*45	Mar., 1920 0.25
East Butte	Boston	4½	4	4¼	Dec., 1919 0.50
First National	Boston Curb	*31	*28	*28	Feb., 1919 0.15
Franklin	Boston	*55	*40	*40	...
Gadsden Copper	Boston Curb	*56	*52	*55	...
Granby Consol.	New York	19	17⅛	18⅞	May, 1919 1.25
Greene-Cananea	New York	17⅛	16	16½	Nov., 1920 0.50
Hancock	Boston	1	1	1	...
Howe Sound	N. Y. Curb	3	2⅞	2⅞	Ap.1,Ap.15, Q 0.05
Inspiration Consl.	New York	30⅞	29¼	30⅛	De.20, Ja.7, Q 0.50
Iron Cap	Boston Curb	1⅞	1⅞	1⅞	May, 1923 0.15
Isle Royale	Boston	*17½	*16½	*16½	Se. 1, Se. 15 0.50
Jerome Verde Dev.	N. Y. Curb	*96	*92	*92	...
Kennecott	New York	54⅝	53⅜	54⅜	De.2, Ja.2, Q 0.75
Keweenaw	Boston	*95	*95	*95	...
Lake Copper	Boston	...	...	1	...
Magma Copper	New York	38¼	37	37½	Jan., 1919 0.50
Mason Valley	N. Y. Curb	1⅞	1⅜	1⅝	...
Mass Consolidated	Boston	...	...	⅞	Nov., 1917 1.00
Miami Copper	New York	22¾	22¼	22½	No.1 No.15 Q 0.50
Mohawk	Boston	36	34½	35½	Se. 22, Oc. 13 1.00
Mother Lode Coa.	New York	8½	8¼	8½	De. 12, De. 31 0.37½
Nevada Consol.	New York	15¾	14⅞	15⅛	Sept., 1920 0.25
New Cornelia	Boston	23	22¼	23	No. 7, No. 24 0.25
New Dominion	N. Y. Curb	...	...	2½	...
North Butte	Boston	2¾	2½	2⅝	Oct., 1918 0.25
Ohio Copper	N. Y. Curb	1⅞	1¾	1⅞	No.14, De.2 0.05
Old Dominion	Boston	23¼	23	23⅛	Dec., 1918 1.00
Phelps Dodge	Open Mar.	†104	†100	...	De.2, Ja.2 Q 1.00
Quincy	Boston	26	22½	26	Mar., 1920 1.00
Ray Consolidated	New York	16½	15⅞	15⅝	Dec., 1920 0.25
Ray Hercules	N. Y. Curb	*14	*8	*9	...
St. Mary's Min. Ld.	Boston	37½	37	37½	Ap.22, My.20 3.00
Seneca Copper	New York	1⅝	1¼	1½	...
Shannon	Boston	1¼	*99	1	Nov., 1917 0.25
Shattuck Arizona	New York	7¼	7	7	Jan., 1920 0.25
Superior & Boston	Boston	1⅝	1¼	1¼	...
Tenn. C. & C.	New York	8½	8⅜	8⅜	De.31, Ja.15,Q 0.25
United Verde Ex.	N. Y. Curb	28⅝	27½	28	Ja. 2, Fe. 2 0.50
Utah Copper	New York	84	83	83½	De.12, De.31,Q 1.00
Utah Metal & T.	Boston	*30	*22	*30	Dec., 1917 0.50
Victoria	Boston	*90	*75	*75	...
Walker Mining	N. Y. Curb	...	...	3¼	...
Winona	Boston	*31	*25	*30	...
NICKEL-COPPER					
Internat. Nickel	New York	24½	23½	23½	March, 1919 0.50
Internat. Nickel pfd.	New York	93¼	93¼	93½	Oc.16, No.1, Q 1.50
LEAD					
Carnegie Lead & Zinc	Pittsburgh	3½	3½	3½	...
National Lead	New York	165	158	162¼	De.12, De.31, Q2.00
National Lead pfd.	New York	116½	116¼	116½	No.21,De.15, Q 1.75
St. Joseph Lead	New York	45⅞	40	42⅛	De. 9, De. 20 0.50
ZINC					
Am. Z. L. & S	New York	11¼	10½	10½	May, 1920 1.00
Am. Z. L. & S. pfd.	New York	35	33⅞	34	Nov., 1920 1.50
Butte C. & Z.	New York	8⅜	7⅞	8⅛	De.10, De.24 0.50
Butte & Superior	New York	21⅜	20⅛	20⅛	June, 1924 0.50
Callahan Zn-Ld.	New York	4⅛	4	4	Dec., 1920 0.50
New Jersey Zn.	N. Y. Curb	191⅞	185	190	Oc.,No.,'24 QX 4.00
United Zinc	N. Y. Curb	...	...	*20	...
Yellow Pine	Los Angeles	*67½	*59½	*67	De.10, De.15 Q 0.4
SILVER					
Alvarado	Boston Curb	1⅛	1⅛	1⅛	...
Beaver Consol.	Toronto	*24¾	*23¼	*24¼	May, 1920 0.03
Castle-Trethewey	Toronto	*73½	*71	*72½	...
Coniagas	Toronto	2.20	2.10	2.10	Ap.20, My.1 0.02½
Crown Reserve	Toronto	*49½	*47½	*49	Jan., 1917 0.05
Keeley	Toronto	2.10	2.07	2.09	Sept. 15, SA 0.12
Kerr Lake	N. Y. Curb	2	2	2	Oc. 1, Oc. 15, 0.12½
La Rose	Toronto	*8	*7	*7½	Apr., 1922 0.10½
Lorrain Trout Lake	Toronto	1.40	1.34	1.35	...
McKinley-Dar.-Sav.	Toronto	*16	*15¼	*15½	Oct., 1920 0.03
Mining Corp. Can.	Toronto	2.75	2.64	2.70	Sept., 1919 0.12½
Nipissing	N. Y. Curb	6¾	6¼	6¾	De.31,Ja.20,QX0.30
Ontario Silver	New York	6	6	6	Jan., 1919 0.50
Temiskaming	Toronto	*21	*21	*21	Jan., 1920 0.40
GOLD					
Alaska Gold	New York	*15	*12	*12	...
Alaska Juneau	New York	1⅛	1	1⅛	...
Argonaut	Toronto	*29	*28	*28¾	...
Carson Hill	Boston	*80	*70	*75	...
Consol. W. Dome L.	Toronto	*16	*15½	*15½	...
Cresson Consol. G.	N. Y. Curb	3¼	3⅛	3¼	De.31, Ja.10 Q 0.50
Dome Mines	New York	13⅜	13½	13½	De.31, Ja.20, Q 0.50
Golden Cycle	Colo. Springs	1.37	1.37	1.37	Dec.11, 1924 0.03
Hollinger Consol.	Toronto	14.95	14.60	14.90	De.11, De.31, 0.05
Homestake Mining	New York	42½	41	42⅜	De.11, De.26, MO 0.50
Jib, Cons'd	N.Y. Curb	*63	*51	*54	...
Kirkland Lake	Toronto	*48	*28¼	*30	...
Lake Shore	Toronto	4.50	4.45	4.46	De.1,De.15,QX 0.10
McIntyre-Porcupine	New York	15½	14⅞	15¼	No. 1, De. 1 0.25
Newray	Toronto	*24	*23½	*23¾	...
Night Hawk Pen.	Toronto	...	...	*4	...
Portland	Colo. Springs	...	...	*44½	Oct., 1920 0.01
Teck-Hughes	Toronto	1.16	1.13	1.15	...
Tom Reed	Los Angeles	*22½	*21	*22½	Dec., 1919 0.02
Tough-Oakes	Toronto	*37½	*36	*36½	...
United Eastern	N. Y. Curb	*40	*30	*38	Jy.18, Jy.31, Q 0.05
Vipond Cons.	Toronto	1.35	1.29	1.31	...
Wright-Hargreaves	Toronto	3.95	3.93	3.94	De.15, Ja.2,QX 0.05
GOLD AND SILVER					
Black Oak	N. Y. Curb	...	...	*81	...
Con. Cortez	N. Y. Curb	*10	*10	*10	...
Con. Virginia	San Francisco	5½	5½	5½	...
Continental Mines	N. Y. Curb	1½	1	1½	...
Dolores Esperanza	N. Y. Curb	...	...	*31	Jy.1, Jy.10 Q 0.05
Premier Gold	N. Y. Curb	2⅝	2⅜	2⅝	De.22, Ja.5,QX 0.10
Tonopah Belmont	N. Y. Curb	*54	*51	*51	Apr., 1923 0.05
Tonopah Divide	N. Y. Curb	*21	*21	*21	Se. 22, Oc. 10 0.10
Tonopah Extension	N. Y. Curb	3	2⅛	3	De.11, Ja.1 0.05
Tonopah Mining	N. Y. Curb	1⅞	1¾	1¾	Se.20, Oc.31 0.07½
Unity Gold	N. Y. Curb	*70	*65	*65	...
West End Consol.	N. Y. Curb	...	...	*46	Mar., 1923 0.05
Yukon Gold	N. Y. Curb	...	...	*50	June, 1918 0.02
SILVER-LEAD					
Ahumada	Boston Curb	7⅜	7¼	7⅜	De.15, Ja.2, X 0.15
Bingham Mines	Boston	27	25⅞	26¼	De.20, Ja.2 0.50
Cardiff M. & M.	Salt Lake	1.15	1.15	1.15	De.16, No.18 0.10
Chief Consol.	Boston Curb	4	3⅜	3½	Ap.19, My.1,Q 0.10
Columbus Rexall	Salt Lake	*25½	*25½	*25½	Aug., 1920 0.03
Consol. M. & S.	Montreal	48	47¾	48	De.11, Ja.15 0.75
Daly Mining	Salt Lake	...	...	1.50	July, 1920 0.10
Erupcion	Boston Curb	2⅜	2¼	2¼	De.15, Ja.2, X 0.15
Federal M. & S.	New York	22¼	18½	22¼	Jan., 1909 1.50
Federal M. & S. pfd.	New York	62¾	57½	60	No.25, De.15, 1.75
Florence Silver	Spokane	5⅜	5	5	Apr., 1919, QX 0.01
Hecla Mining	N. Y. Curb	*10⅜	*10⅛	*10⅜	No.15, De.15 0.25
Iron Blossom Con.	N. Y. Curb	...	...	*28	Oc.25, 1924 0.02½
Marsh Mines	N. Y. Curb	*5	*5	*5	June, 1921 0.02½
Park City	Salt Lake	5	5	5	De. 15, Ja.4 0.15
Park Utah	N. Y. Curb	...	...	3½	Mc. 15, Ap. 1 0.15
Prince Consol.	Salt Lake	*16½	*15½	*16½	...
Silver King Coal	Salt Lake	5.60	5.50	5.55	De.20, Ja.2, Q 0.50
Silversmith	Spokane	*30	*29	*29½	Oc. 1, Oc. 10 0.01
Tamarack-Custer	Spokane	1.28	1.10	1.10	Se. 22, Se. 29 0.25
Tintic Standard	Salt Lake	8.25	7.50	7.70	Ja.2, QX 0.50
Utah-Apex	Boston	3⅛	3⅛	3⅛	Se.5, Se.15, Q 0.25
IRON					
Bethlehem Steel	New York	49½	48¼	49¼	Jn.1, Jy.1, Q 1.25
Char. Iron	Detroit	*29	*27	*28	...
Char. Iron pfd.	Detroit	*90	*80	*81	...
Colorado Fuel & Iron	New York	45¼	40½	42½	Au.11, Au.25,Q 2.00
Col. Fuel & Iron pfd.	New York	...	...	108¼	No.10, No.26 Q 2.00
Gt. North'n Iron Ore	New York	35	33¼	33¾	De.10, De.27 2.00
Inland Steel	N. Y. Curb	...	...	4	No.14, De.1, Q 0.62½
Mesabi Iron	N. Y. Curb	...	...	2⅞	...
Replogle Steel	New York	22½	21	22½	...
Republic I. & S.	New York	57¼	55	57	May, 1921 1.50
Republic I. & S. pfd.	New York	94	92	92½	De.16, Ja.2, Q 1.75
Sloss-Sheffield S. & I.	New York	84⅝	79½	82½	Se.11, Se.20, Q 1.50
Sloss-Shef. S.&I. pfd.	New York	95½	94	94	De.20, Ja.2, Q 1.75
U. S. Steel	New York	119⅜	117½	118¼	No.29,De.3, QX 1.75
U. S. Steel pfd.	New York	121⅞	121	121⅝	No.4, No.29, Q 1.75
Virginia I. C. & C.	New York	41½	39	41½	De.15, Ja.2 1.50
Virginia I.C.&C.pfd.	New York	...	...	78½	De. 13, Ja. 2, Q 2.50
VANADIUM					
Vanadium Corp.	New York	32⅜	28½	31¾	Jan., 1921 1.00
ARSENIC					
Western Utah Copper	N. Y. Curb	...	...	*15	...
ASBESTOS					
Asbestos Corp.	Montreal	38½	36	36	Se.29, Oc.15 Q 1.00
Asbestos Corp. pfd.	Montreal	74	73¼	73¾	Ja.2, Ja.15, Q 1.50
SULPHUR					
Freeport Texas	New York	11⅜	9⅞	10	Nov., 1919 1.00
Texas Gulf	New York	103	93¼	102	De.1,De.15, QX 2.25
PLATINUM					
So. Am. Gold & P.	N. Y. Curb	4	3⅝	3⅝	...
MINING, SMELTING AND REFINING					
Amer. Metal	New York	50⅞	49⅝	50	No.19, De.1 Q 0.75
Amer. Metal pfd.	New York	...	...	114½	No.20, De.1, Q 1.75
Amer. Sm. & Ref.	New York	91⅜	88	90⅞	Oc.17, No.1, Q 1.25
Amer.Sm.&Ref.pfd.	New York	106	105½	106	No.17, De.1 Q 1.75
U. S. Sm. R. & M.	New York	37½	36	37	Jan., 1921 0.50
U.S. Sm. R.&M.pfd.	New York	46	45⅝	45½	Oc.9, Oc.15 Q 0.87

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.

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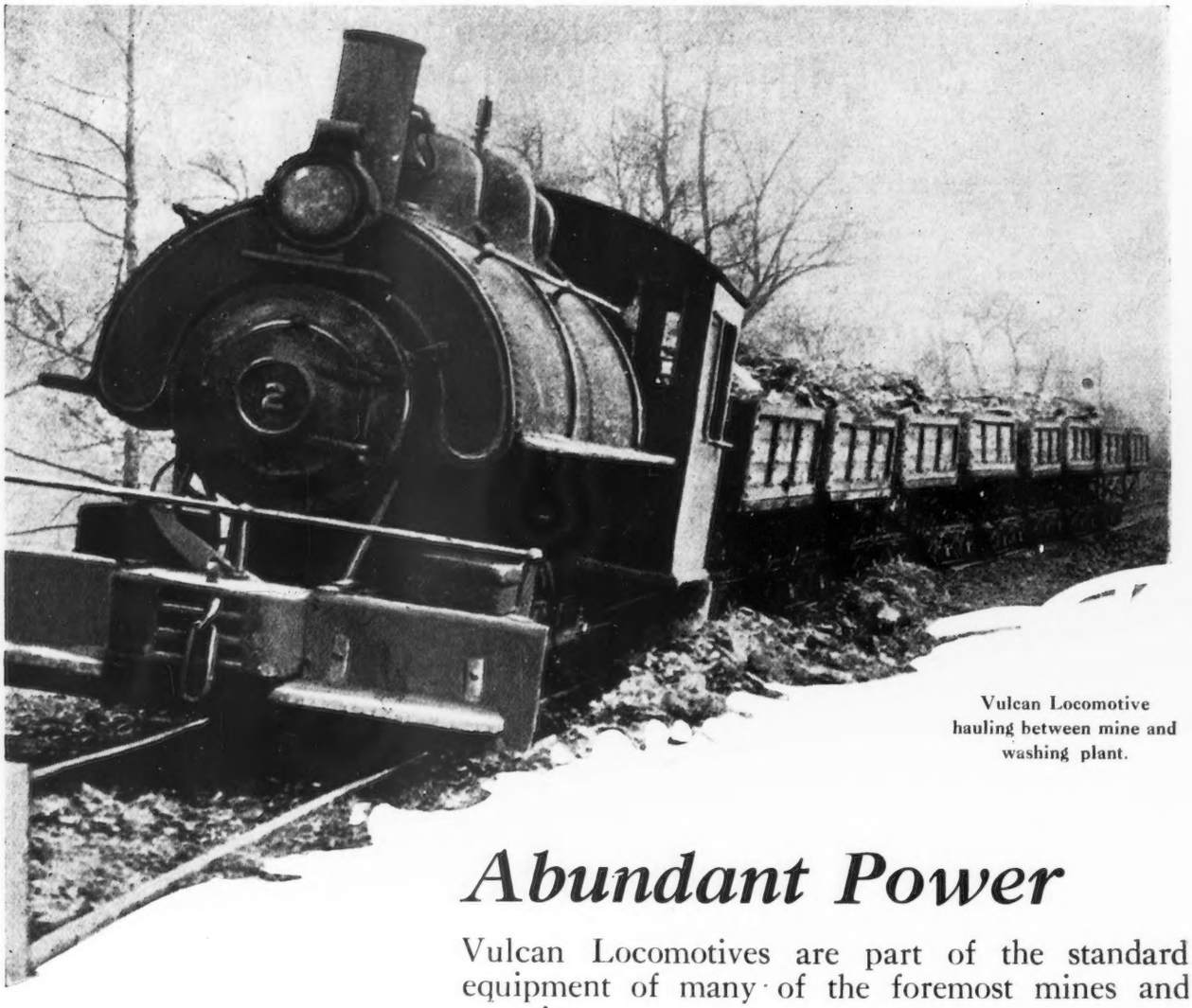

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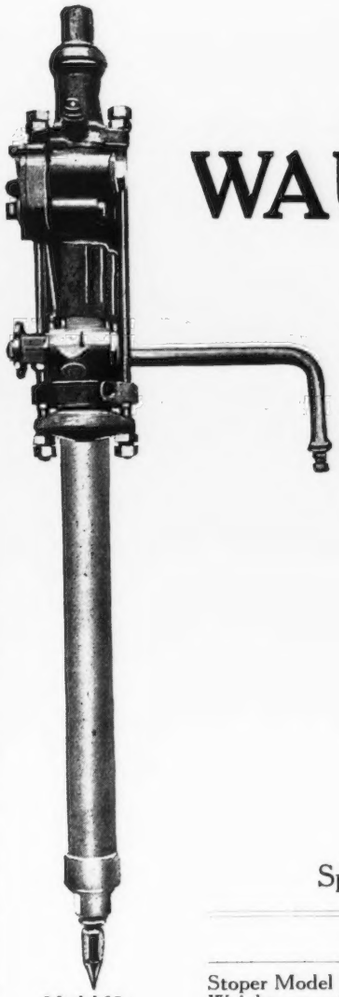

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Length, inches	54	54	55	55	56
Length of feed, in	24	24	24	24	24
Diameter feed cyl., in	2⅛-2¼	2⅛-2¼	2⅛-2¼	2⅛-2¼	2⅝-3
Rotation	Hand	Hand	Hand	Hand	Independent
Air Feed	Direct	Reverse	Direct	Reverse	Direct or Reverse
Size drill steel, in.	⅞-1⅛	⅞-1⅛	⅞-1⅛	⅞-1⅛	⅞-1⅛
Size of air hose, in.	¾	¾	¾	¾	¾-1
Size of water hose, in.	.....	.....	⅜-½	⅜-½	⅜-½

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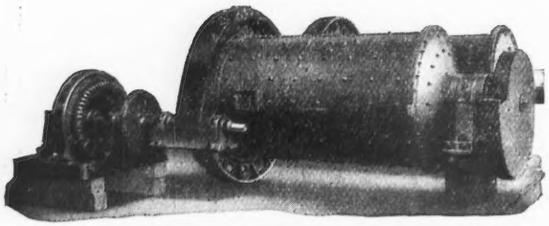
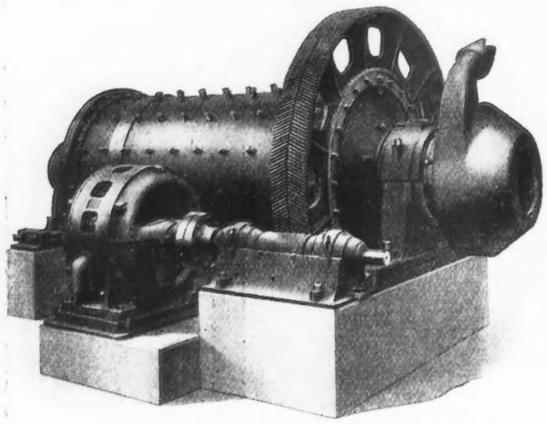
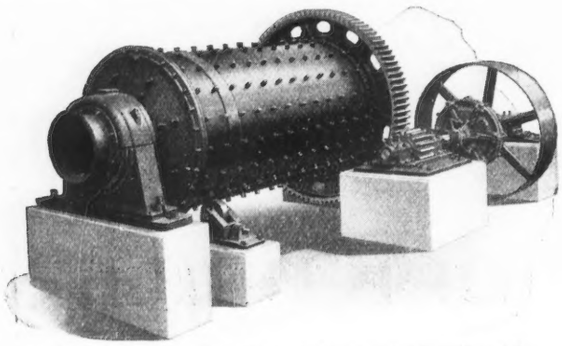


7x12-ft. Ball-peb Granulator. One of three installed by Phelps Dodge Corp. Herringbone gear drive through magnetic clutch to 250 hp., 300 r.p.m. Allis-Chalmers Synchronous Motor.



5x10-ft. Rod Mill. Direct connected to 100 hp. Slip Ring Motor.



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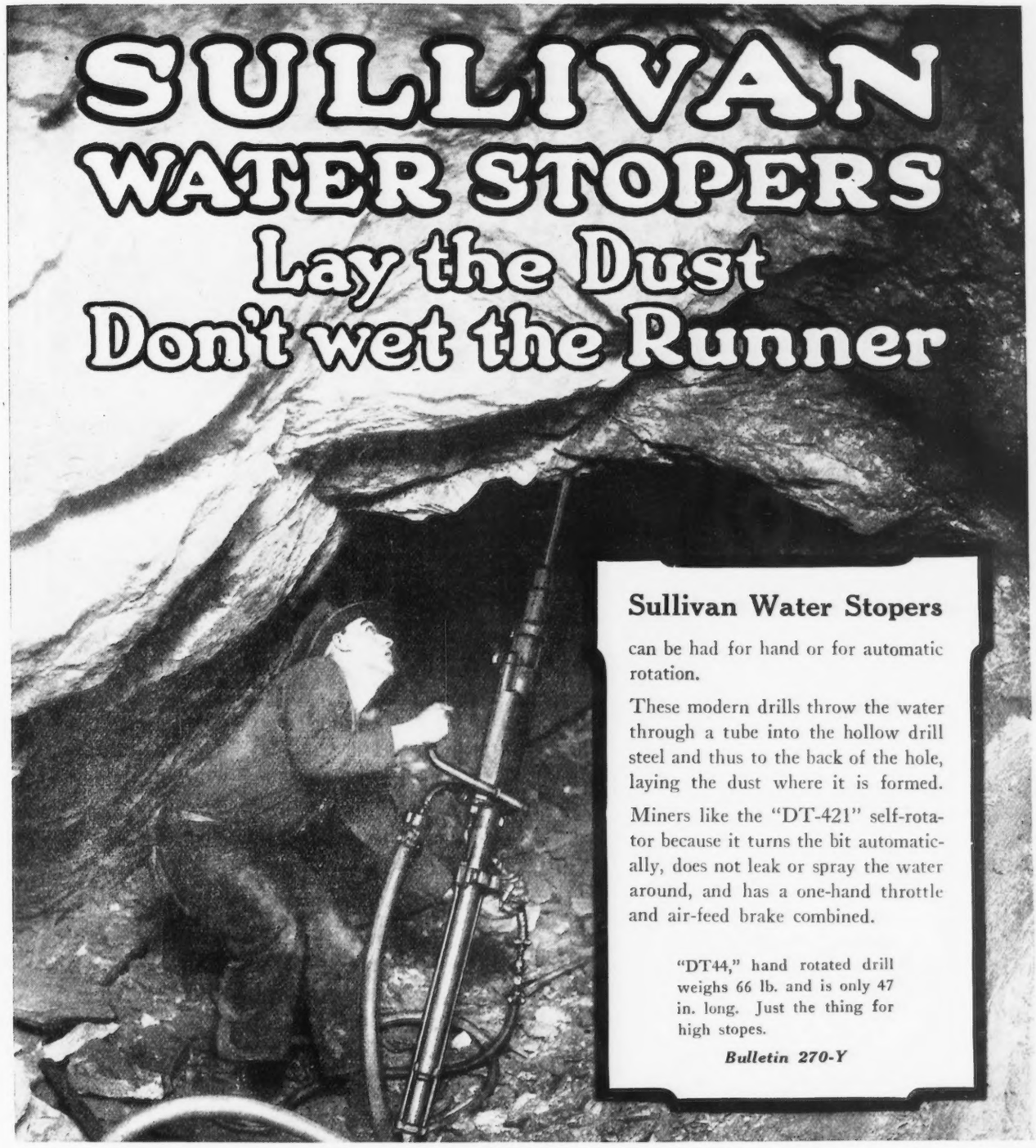

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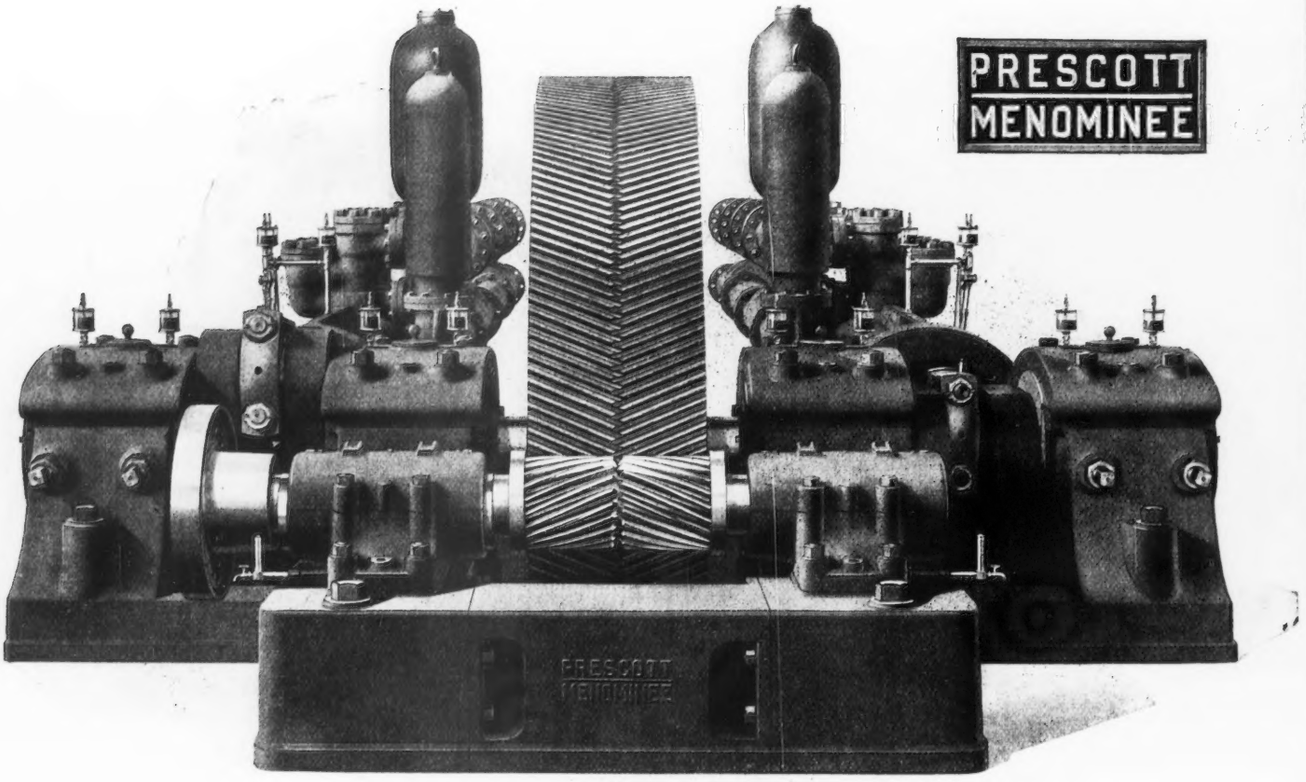
Algiers, Brussels, Calcutta, Christiania, Durban, Natal, Havana, Lima, London, Madrid, Mexico City, Paris, San Juan, Santiago, Shanghai, Sydney, N. S. W., Tokyo, Toronto, Tunis, Turin, Vancouver.



Pump design that assures efficiency

The entire power end of the Prescott-Menominee duplex electric mine pump is heavy and strong, with the absolute solidity and rigidity which is so important to a motor-driven geared pumping unit.

The single reduction set of helical herringbone gears, used in nearly all Prescott-Menominee Electric Pumps, are mounted on standard heavy hydraulic type of frames, which are rigidly cross connected at the gear ends.

The main journals are large and fitted with four part bearings provided with adjustments for taking up wear. Pinion bearings are fitted with removable shells and automatic ring oilers.

Fluid ends have direct, straight passages and large valve areas. Large suction and discharge air chamber insure quiet and smooth operation and a constant uniform velocity of discharge.

The efficiency and economy of operation of Prescott-Menominee Pumps is due to these better construction principles. Write for booklet that describes different types in detail.

THE PRESCOTT COMPANY

Fred. M. Prescott, President

MENOMINEE, MICH.

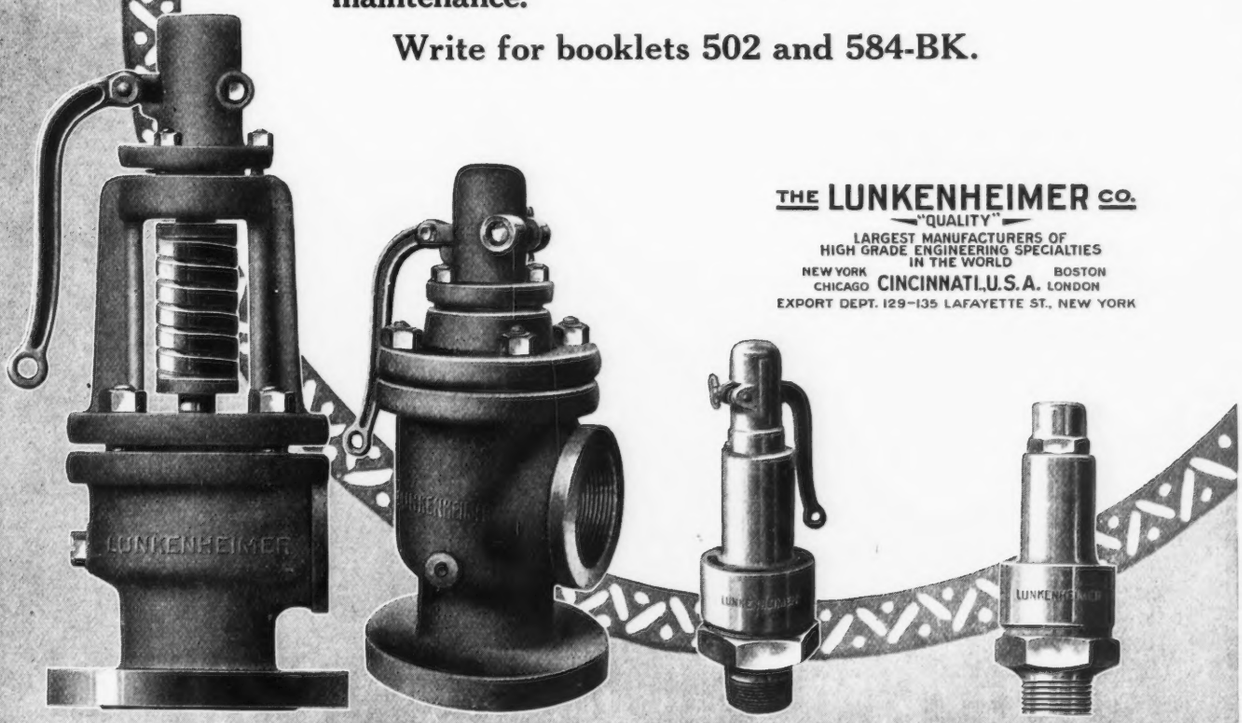
LUNKENHEIMER

Pop Safety and Relief Valves

A most extensive line of a large number of designs made in various combinations of materials, permitting of a broad choice for any service, pressure or temperature.

Reliable, durable and economical in operation and maintenance.

Write for booklets 502 and 584-BK.



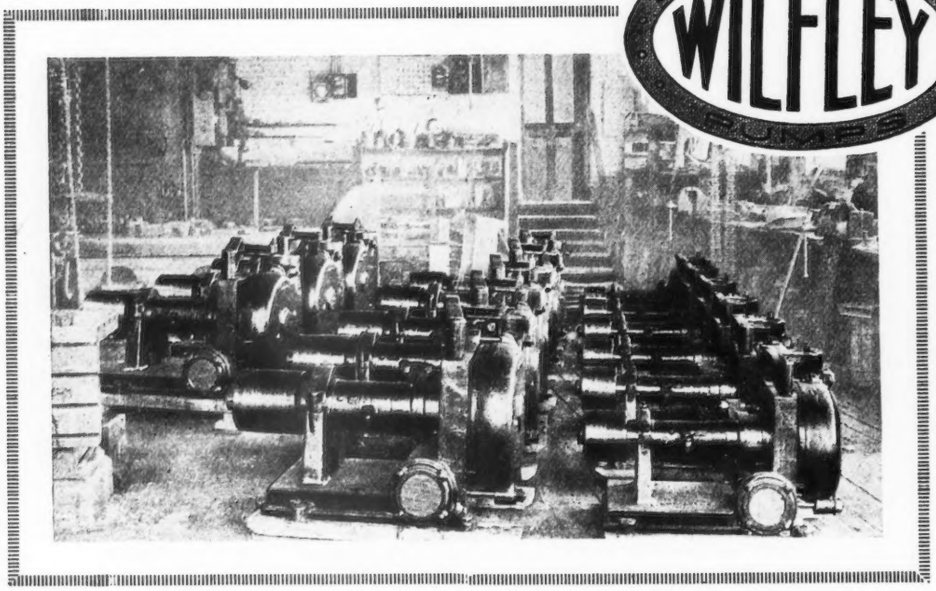
THE LUNKENHEIMER CO.
"QUALITY"
LARGEST MANUFACTURERS OF HIGH GRADE ENGINEERING SPECIALTIES IN THE WORLD
NEW YORK BOSTON
CHICAGO CINCINNATI, U.S.A. LONDON
EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

Fig. 146 Iron Body Bronze Mounted Outside Spring Pop Safety Valve	Fig. 630 Iron Body Bronze Mounted Encased Spring Pop Safety Valve	Fig. 433 Bronze Encased Spring Top Outlet Pop Safety Valve	Fig. 656 Bronze Encased Spring Top Outlet Cylinder Relief Valve

"America's Best since 1862"

4-24-20

WILFLEY



Thick Pulps (60-70% Solids)

Thick Pulp, such as filter feed, concentrates, ball and rod mill products, and cement slurry are satisfactorily and economically handled with the Wilfley Pump.

Also — This pump does not dilute the pulp handled because the Wilfley patented centrifugal seal dispenses with the use of gland water, thereby insuring a constant pulp consistency so essential in flotation practice.

WILFLEY Centrifugal SAND PUMP

PATENTED

A. R. Wilfley & Sons

DENVER, COLO., U. S. A.

Christmastide

the trail's end of the old year, is here again, bringing memories of old days, old times and friends. Our hearts go out to the readers of the

"Engineering and Mining Journal-Press"

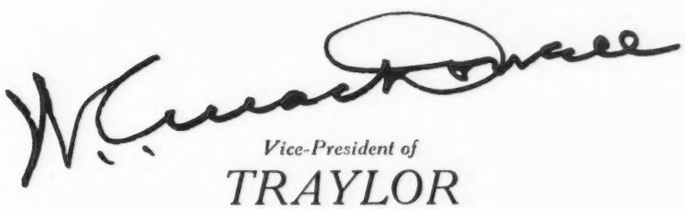
for a

Merry Christmas
and
A Heaping Measure
of
Happiness and Prosperity

during

1925

Pledging, the while, continuance of that service it has been a pleasure and privilege to render in the past.



Vice-President of
TRAYLOR
at Allentown, Penna.

Attack Mother Earth With Alloy Steels

Combat the wear and tear on your equipment by using Agathon Alloy Steels. They lengthen the life of your product, enhance its reputation and gain you added good will from your customers. We produce alloy steels to meet various requirements. Some are of a special analysis to resist wear—others to resist shock—others are tough but not hard—and still others have hardness but are not brittle. Our expert metallurgists and practical steel men will gladly help you solve your steel problems without charge. Write us. Ask for booklet, "Agathon Alloy Steels."

We have daily production in all kinds of Agathon Alloy Steels such as—

Nickel, Chrome-Nickel, UMA, Molybdenum, Chrome-Molybdenum, Nickel-Molybdenum, Vanadium, Chrome-Vanadium, Chromium, etc.

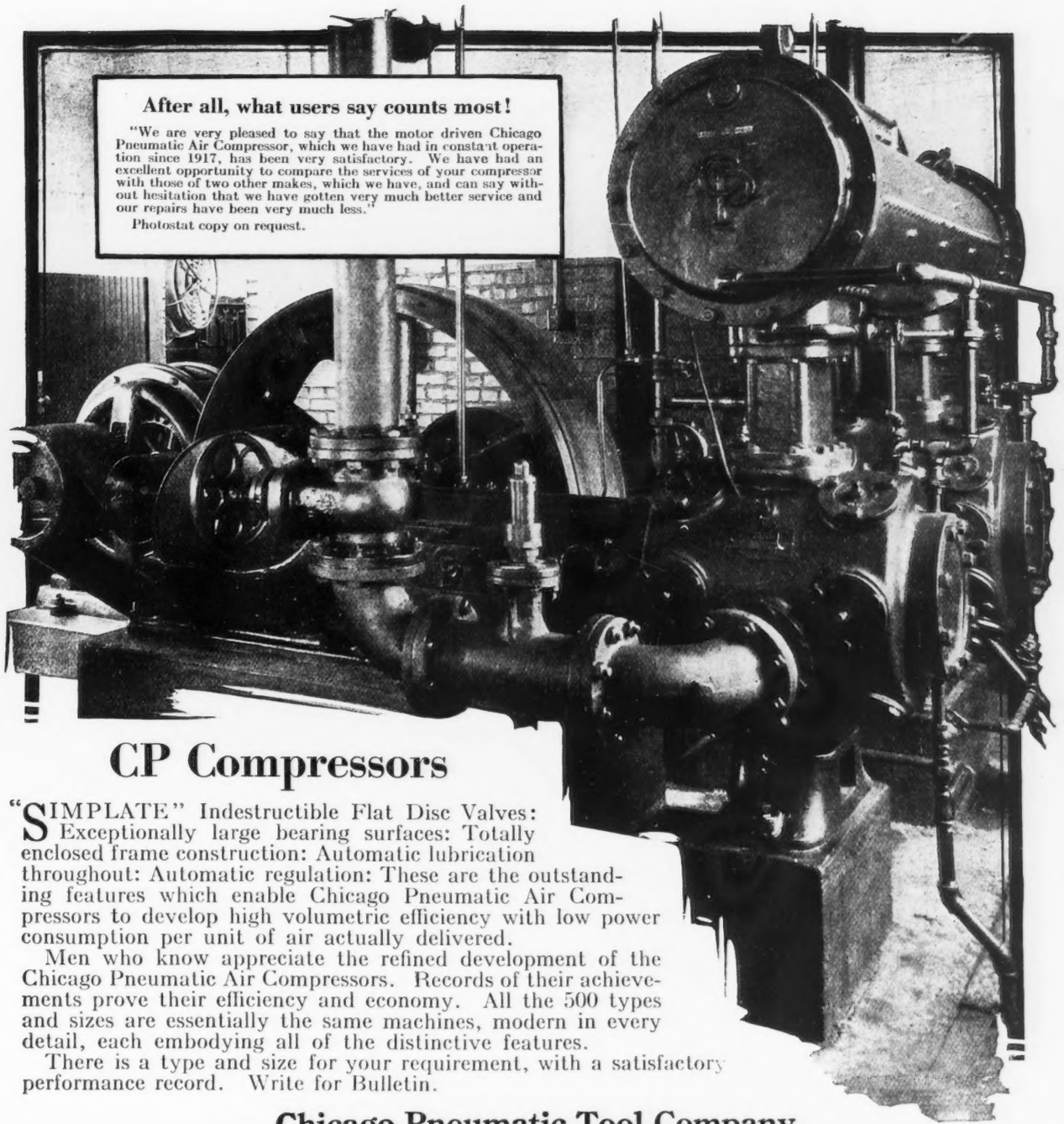
Deliveries in Blooms, Billets, Slabs, Bars, Spring Flats, Hot Rolled Strips, etc.

AGATHON STEELS

THE CENTRAL STEEL COMPANY, Massillon, Ohio

Aeolian Bldg. New York · Swetland Bldg. Cleveland · Book Bldg. Detroit · Peoples Gas Bldg. Chicago · Universal Block Syracuse · Widener Bldg Philadelphia

AGATHON ALLOY STEELS



After all, what users say counts most!

"We are very pleased to say that the motor driven Chicago Pneumatic Air Compressor, which we have had in constant operation since 1917, has been very satisfactory. We have had an excellent opportunity to compare the services of your compressor with those of two other makes, which we have, and can say without hesitation that we have gotten very much better service and our repairs have been very much less."

Photostat copy on request.

CP Compressors

"SIMPLATE" Indestructible Flat Disc Valves: Exceptionally large bearing surfaces: Totally enclosed frame construction: Automatic lubrication throughout: Automatic regulation: These are the outstanding features which enable Chicago Pneumatic Air Compressors to develop high volumetric efficiency with low power consumption per unit of air actually delivered.

Men who know appreciate the refined development of the Chicago Pneumatic Air Compressors. Records of their achievements prove their efficiency and economy. All the 500 types and sizes are essentially the same machines, modern in every detail, each embodying all of the distinctive features.

There is a type and size for your requirement, with a satisfactory performance record. Write for Bulletin.

Chicago Pneumatic Tool Company

6 East 44th Street, NEW YORK, N. Y.

*Sales and *Service Branches all over the World*

*Birmingham	*Cleveland	Houston	*New York	Salt Lake City	Tulsa	Brussels	Havana	London	Montreal	Rotterdam	Shanghai	*Vancouver	
*Boston	Denver	*Los Angeles	*Philadelphia	*San Francisco	Basle	*Buenos Aires	Helsingfors	Manila	Osaka	Santiago	Tampico	*Winnipeg	
*Chicago	*Detroit	*Minneapolis	*Pittsburgh	Seattle	Berlin	Christiania	Honolulu	Milan	Paris	*Sao Paulo	Tokyo		
*Cincinnati	El Paso	*New Orleans	Richmond	*St. Louis	Bombay	Dairen	Johannesburg	*Montevideo	*Rio de Janeiro	Seoul	*Toronto		

Canadian Pneumatic Tool Company, Ltd., Montreal, manufacturers of Chicago Pneumatic products in Canada.

C-140

BOYER PNEUMATIC HAMMERS · · LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS · · VACUUM PUMPS · · PNEUMATIC HOISTS,
GIANT OIL AND GAS ENGINES ROCK DRILLS · · COAL DRILLS

CHICAGO PNEUMATIC

The Compressor with the Simplate Valve

New York will never go dry

THE water supply system for Greater New York was designed with the thoughts of reserve supply and safety foremost. Up in the Catskills, near the source of this water supply, is the Ashokan reservoir. This is ample for New York in the far distant future. A few miles away is the Kensico reservoir, built for safety. On the outskirts of the city there is a third reservoir, and on Staten Island a fourth.

Linde's national system of 115 plants and warehouses is like the New York water system. The reserve facilities of any or all of these plants and warehouses can be directed toward the single plant or warehouse that is your source for oxygen.

THE LINDE AIR PRODUCTS COMPANY
General Offices: Carbide & Carbon Bldg.
30 East 42d Street, New York
38 PLANTS—77 WAREHOUSES

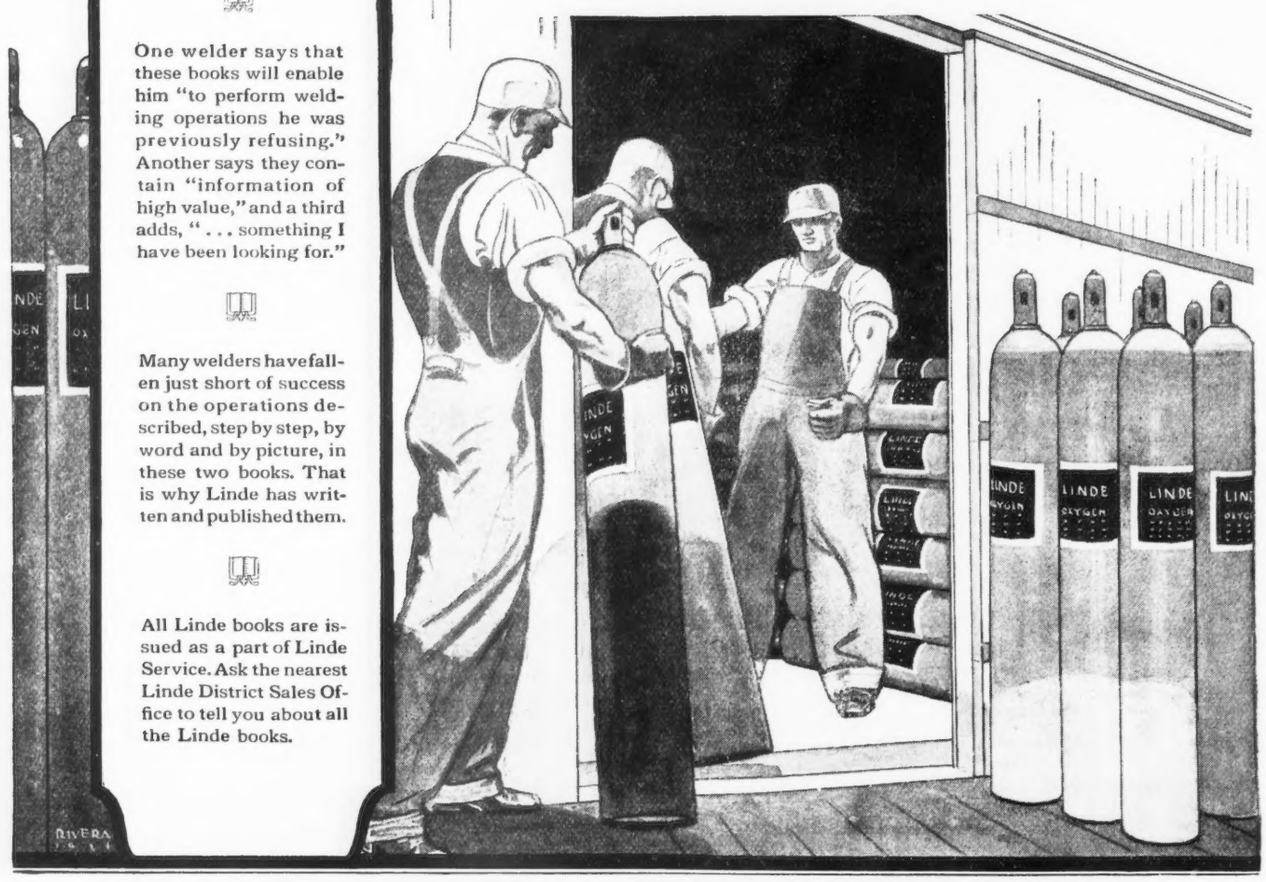
Step by Step

The Linde Company has recently issued two new books: *"Step by Step in Gas Welding a Crank Case"* and *"Step by Step in Gas Welding a Cylinder Block."* Like all Linde books, they are written from practical experience and to fill a definite need.

One welder says that these books will enable him "to perform welding operations he was previously refusing." Another says they contain "information of high value," and a third adds, "... something I have been looking for."

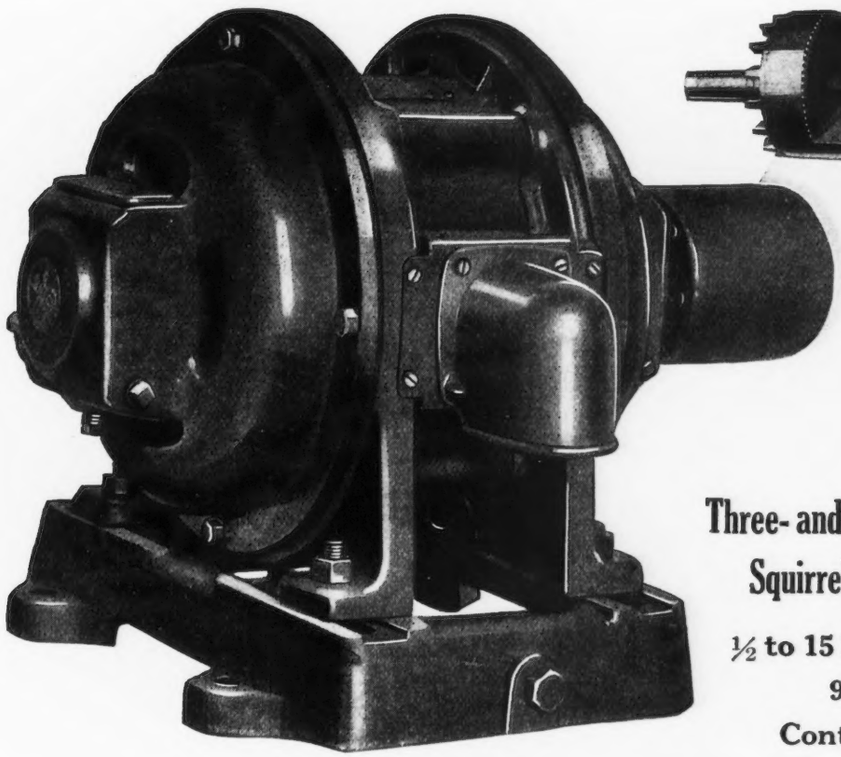
Many welders have fallen just short of success on the operations described, step by step, by word and by picture, in these two books. That is why Linde has written and published them.

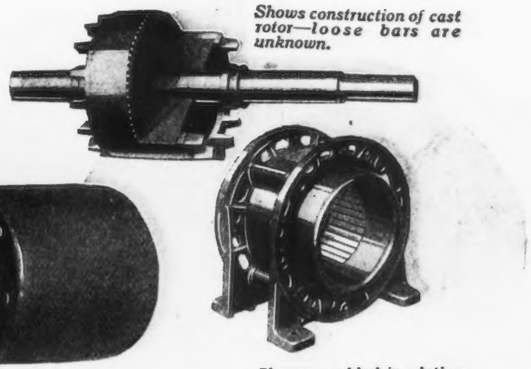
All Linde books are issued as a part of Linde Service. Ask the nearest Linde District Sales Office to tell you about all the Linde books.



LINDE OXYGEN

YOU CAN DEPEND ON THE LINDE COMPANY





Shows construction of cast rotor—loose bars are unknown.

Shows moulded insulation of stator—smooth and easily cleaned.

Three- and Two-Phase Constant Speed Squirrel Cage Induction Motors

½ to 15 H.P. (Types KT and KQ)
900 Series Frames
Continuous Duty—40° C.

To build motors that meet users' needs and to render service that insures satisfaction to the purchaser is the constant aim of the General Electric Company. Excellent mechanical and electrical construction in the new "900 series" motors insure exceptional operating characteristics.

Outstanding features of the "900 Series" are:

Electrical—

Ample starting torque and rapid acceleration.
Maximum pullout torque over 250% of full load torque.
Less than 6% slip.
Temperature rise at full load will not exceed 40° C.

Mechanical—

Large dustproof oil wells—frequent replenishment unnecessary.
Sliding base, easily mounted on wall, floor or ceiling—permits quick change of belt tension without affecting alignment.
Large conduit terminal box—facilitates making connections.
Paper pulley transmits full power at low belt tension.
Moulded insulation provides additional protection to well insulated field windings and also enables the motor to be operated successfully where exposed to magnetic or abrasive dust, or to weak acid or alkaline fumes.

The new 900 series motor does its work well, requires little attention, has a low maintenance cost, and uses power efficiently—just what every user wants.

General Electric engineers study the power requirements of all industries. Through adequate manufacturing facilities, their efforts result in a combination of motors and control closely adapted to the service to be performed.

General Electric Company
Schenectady, N. Y.

Sales Offices and Motor Dealers in All Large Cities

45-246

GENERAL ELECTRIC

SEARCHLIGHT SECTION

USED EQUIPMENT & NEW—BUSINESS OPPORTUNITIES

UNDISPLAYED—RATE PER WORD:

Positions Wanted, 4 cents a word, minimum 75 cents an insertion, payable in advance.

Positions Vacant and all other classifications, 8 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of any of our offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 to 3 inches.....$1.50 an inch
4 to 7 inches..... 4.35 an inch
8 to 14 inches..... 4.10 an inch

Rates for larger spaces, or yearly rates, on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

E.&M.J.-P.

EMPLOYMENT SERVICE

SALARIED men seeking tentative offers of new connections, are invited to communicate confidentially with the undersigned, who will negotiate overtures without jeopardy to present connections. A professional, ethical service, restricted to high grade positions; established 1910. Retaining fee refunded as provided in our "Refund Contract" if service is not satisfactorily rendered as per contract, and such refund be requested within three months from date remitted. Send name and address only for particulars. R. W. Bixby, Inc., 704 Lockwood Building, Buffalo, New York.

EXECUTIVES, engineers, will find our individual, confidential service an effective medium in making new connections. Personally conducted by Mr. Jacob Penn, the eminent employment authority, known to leading business men throughout America. Our refund agreement protects you. Not employment agency Jacob Penn, Inc., 305 Broadway, N. Y.

EMPLOYMENT AGENCY

WANTED at once—9 mine shift bosses Latin-America, $225; cyanide shift boss, Orient, $180; mining engineer, assistant superintendent, West Indies, $250; position, mine, Central America, $300; assayer, Mexico, $175; eight mining engineering graduates, $135. For these and others write or wire, no red tape, no delay. Interstate Employment, First National Bank Bldg., Denver, Colorado.

POSITIONS WANTED

ELECTRICIAN, repair, installation, operation. **All electrical apparatus. 15 years mine work. Address, PW-106, Engineering & Mining Journal-Press, 883 Mission St., San Francisco, Calif.**

ENGINEER and draftsman, ten or twelve years' almost continuous experience with large mines. Mostly as draftsman. PW-124, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

EXPERIENCED hydraulic miner desires position as superintendent or foreman. **PW-120, Eng. & Min. Journal-Press, 883 Mission St., San Francisco, Cal.**

METALLURGICAL superintendent, 12 years' experience smelting copper and lead. Refining tin, solder, brass, bronze and aluminum. Concentration of ashes and skimmings. Recovery of by-products. Foundry practice. Buying and selling of metal products. Will consider position as superintendent or consulting chemist. Available on month's notice. PW-123, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

POSITIONS WANTED

MILL man, wants position as superintendent of cyanide mill. Many years' experience, best references. Spanish spoken. New York interview. PW-132, Eng. & Min. Journal-Press, Real Estate Trust Bldg., Philadelphia, Pa.

MINE foreman will go anywhere. Formerly employed by Superior California Mine Co. as foreman; 12 years' experience; 42 years old. Understand gold, silver and copper mining. PW-118, Eng. & Min. Journal-Press, 883 Mission St., San Francisco, Cal.

SUPERINTENDENT with 20 years' experience as mine and general superintendent in metal mines of the South West and Mexico, desires a position as superintendent; available in 30 days' notice. PW-114, Eng. & Mining Journal-Press, Old Colony Bldg., Chicago, Ill.

SUPERINTENDENT of metal mines, broad experience, technically trained, open for immediate engagement; capable geologist, accustomed to heavy ground, all systems of mining, shaft work, construction. Familiar with all mining machinery operation and upkeep, working knowledge of milling and assaying. American, middle-aged, strictly temperate, energetic. Several languages including Spanish. No objections to foreign countries. PW-121, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

ZINC man would like to connect with company desiring the services of one familiar with the manufacture of spelter and zinc dust, either in advisory capacity or active management. Thorough knowledge of smelting the large tonnage necessary for low costs. Eighteen years' gas belt experience ranging from chemist to management. Graduate B.S. Employed. Address PW-134, Eng. & Min. Journal-Press, 10th Ave. at 36th St., New York.

BUSINESS OPPORTUNITIES

Twelve Million Yards of Placer Ground for sale, located in the vicinity of Nome. **Ground is thawed. For further information** correspond with the owner, Charley Strom, Nome, Alaska.

FOR SALE

COPPER PROPERTY

The undersigned, sole owner of immense copper prospect, in Mexico, acquired by denouncement, recently titled, desires to sell property on an equitable basis. Present semi-developed condition, estimated to have 3,000,000 tons of ore assaying 2.5% copper, 2.8 ounces silver and 0.85 cents in gold value per ton. Several thousand feet of tunnels, upraises, etc. Vein varies from 75 to 250 feet in width. Extends over mineralized zone for three miles. Mining facilities and climate excellent.

Will sell for cash or for cash and an interest in company formed.

BO-126, Engineering & Mining Journal-Press
10th Ave. at 36th St., New York City.

ESTABLISHED COMPANY

International in scope, has opening for organizer capable investing $5,000 to $10,000 in business. Technical man preferred though not necessary; Contract, salary, commission, expenses. Ability to make good only limit advancement and income.

BO-128, Engineering & Mining Journal-Press
10th Ave. at 36th St., New York City.

TEN MILLION OUNCES SILVER

Potential Annual business; Going concern; Four years in business; Live-Wire Promotor or Broker wanted to handle stock issue. Organization completed. Highest Bank and Commercial references.

BO-127, Engineering & Mining Journal-Press
10th Ave. at 36th St., New York City.

FOR SALE

2—70-hp. Return Tube **Boilers**; 1—25-hp. **Engine**; 1—**Air Compressor**; 1—**Hoist**; 1—**Crusher**; 1—Set **Rolls**; 1—Dorr **Thickener**; 1—No. 7 A. S. Cameron **Sinking Pump, Tanks** for hundred-ton Cyaniting plant. **Twenty Stamps.**

P. O. BOX 12, RICHMOND, VA.

For Inventors

PATENTS. If you have an invention which you wish to patent you can write fully and freely to Munn & Co., for advice in regard to the best way of obtaining protection. Please send sketches, or a model of your invention and a description of the device, explaining its operation. All communications are strictly confidential. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc. "Scientific American" contains Patent Office Notes, Decisions of interest to inventors and particulars of recently patented inventions Munn & Company, Solicitors of Patents, 643 Woolworth Building, New York; 518 Scientific American Bldg., Washington, D. C.; 407 Tower Bldg., Chicago, Ill.; 360 Hobart Bldg., San Francisco, Calif.; 215 Van Nuys Building, Los Angeles, Calif.

Is there such an opening in the United States or Canada?

A mining and metallurgical engineer who has been working in various mining camps in the United States and Canada for the past fifteen years now desires to locate in a city. His work has consisted of mine development and operation, smelter operation, mill construction and operation, and machinery sales.

This engineer is searching for an opening which will lead to permanent employment with a good company allied with the mining industry.

He is 35 years of age, is a hard worker and believes that he has real executive and business ability. All of his former employers recommend him highly.

PW-133, Engineering & Mining Journal-Press, 10th Ave. at 36th St., New York City

Power Equipment

MOTORS

Three Phase, 60 Cycle

No.	Hp.	Make	Volts	Type	Speed
1	400	G. E.	440	I.M.	514
1	300	G. E.	2200	A.T.I.	200
1	150	West.	2200	C.	600
1	135	Cr.-Wh.	2200	C. Spd.	1200
1	100	West.	2200	C.C.L.	600
1	75	West.	440	C.C.L.	720
1	50	G. E.	440	I.T.C.-V.S.	.....
1	50	G. E.	440	L.L.	720
3	50	West.	2200	C.	900

TRANSFORMERS

3—200-kva., 4000-440-220-v.
3—150-kva., 2200-440-220-v.
3—667-kva., 22000-480-240-v.
3—50-kva., 22000-440-220-v.

This is only a partial List of our Stock.

DACHNER ELECTRIC EQUIPMENT CO.
236 Rialto Building, San Francisco, Calif.

FLOTATION BLOWERS

AT BARGAIN PRICES

2—Connersville Blowers, double outboard bearing. Capacity 24-5 cu.ft. per revolution, 3,200 cu.ft. per minute at 255 r.p.m. Maximum pressure 4.58 lbs. per sq. in. at 255 r.p.m.
1—Roots Style D High Pressure Type Blower. Capacity 890 cu.ft. per minute at 435 r.p.m. Maximum pressure 9 lb. per sq. in. at 435 r.p.m.

Write for Prices

Nashville Industrial Corporation
Old Hickory, Tennessee

Cyanide Mill

FOR SALE

We offer the 150-ton cyanide mill of the Nevada Wonder Mining Company, a partial inventory of which follows:

1—10 x 16 Blake Crusher.
1—10-Stamp Mill.
2—Challenge Feeders.
1—5 x 22 Tube Mill.
1—Dorr Duplex Classifier.
2—Cone Classifiers.
4—Senn Concentrators.
5—Dorr Thickeners.
18—Redwood Tanks.
1—20 x 14 Wet Vacuum Pump.
1—12 x 12 Dry Vacuum Pump.
3—Triplex Pumps.
1—16 x 12 Air Compressor.
1—Air Receiver.
5—Centrifugal Pumps.
2—12 x 14 Oliver Filters.
2—12 x 8 Oliver Filters.
1—Boiler and Stack.

Scales, bullion moulds, assay balance, shafting, pulleys, transmission, and usual mill accessories.

Would like to sell plant as a whole, and will name attractive price to interested parties who mean business.

Curtis Machinery Company
441 E. 4th St., Reno, Nevada

FOR SALE

Re-conditioned Machinery

1—30x120-in., Type E, Dwight-Lloyd Sintering Machine.
3—42x264-in., Type E, Dwight-Lloyd Sintering Machines.
The above machines are complete with feeders and blowers.
3—26-ft. Godfrey Roasting Furnaces, with cooling tanks.
1—40x144-in. Silver-Lead Blast Furnace, with C. I. Jackets; made by Colorado Iron Works.
2—48x180-in. Silver-Lead Blast Furnaces with cast iron jackets; made by Colorado Iron Works.
1—36x120-in. Lead-Matte Furnace, steel jackets and cast iron bottom plate.
1—38x180-in. Copper Matting Furnace, steel jackets and iron bottom plates.
1—38x96-in. Copper Smelting Furnace.
5—Single Round Bowl Slag Trucks, 36-in. gauge; bowl 60 in. diam., 30 in. deep; screw dumping device.
4—Single Round Bowl Slag Trucks, 36-in. gauge; bowl 60 in. diam., 30 in. deep; screw dumping device.
4—Drossing Kettles, 8 ft. diam.

BLOWERS

1—No. 5 Roots Positive Blower.
1—No. 6 Connersville Positive Blower.
2—No. 7 Connersville Positive Blowers.
2—No. 8 Connersville Positive Blowers.

We also have a very large and complete stock of motors, both alternating and direct current, generators, boilers, engines hoists, pipe and fittings.

The above is but a partial list of machinery which we have on hand. Write us giving us your specifications of what material you wish and we will be pleased to submit quotations.

The Morse Bros. Machinery & Supply Co.
Broadway and Wewatta Street, Denver, Colo.

MINES SUPPLY AND MACHINERY CO., Inc.

New and Used Equipment
Complete Stock List on Request
589 Bryant St., San Francisco, Cal.

NEW AND REBUILT

Mining and Milling Machinery

Send for Complete List

Agents for:
Allingham Flotation Machines

ROSENBURG & CO. MINING MACHINERY LOS ANGELES
Rosenburg & Co.

3rd & San Pedro Sts. Los Angeles, Cal. — **8th, Madison & Jackson Sts. Phoenix, Arizona**

USED MOTORS

3 Phase, 60 Cycle Motors

Quan.	H.P.	Type	Volt	Speed	Make
1	¼	B.S.T.	440	1800	G.E.
1	½	KT112	440	1200	G.E.
6	½	B	440	1200	F.M.
29	7½	CS170931-A	440	1200	West.
37	7½	13D	440	1200	A.C.
1	7½	3K	440	1200	A.C.
2c	7½	1 Form	440	900	G.E.
5c	10	.....	440	900	G.E.
1	10	17G	440	1200	A.C.
2	10	17C	440	1200	A.C.
8	15	17K	440	1200	A.C.
2	15	17D	440	1200	A.C.
3c	15	.....	440	720	G.E.
1c	15	1 Form	440	900	G.E.
1	30	20G	440	1800	A.C.
2	30	CS	440	1200	West.
6	30	KT332	440	1200	G.E.
4cx	40	MT336Y	440	1200	G.E.
2cx	40	.....	440	1200	West.
2	75	CS160874A	440	1800	West.
5	75	.....	440	720	G.E.
1	150	CS179274B	2200	1800	West.

Single Phase, 60 Cycle Motors

1	10	RI-627	220/110	1800	G.E.

All above motors are squirrel cage with exception of those marked c which are slip ring.

Motors marked cx are vertical slip ring.

Excellent Condition and Priced Right

Nashville Industrial Corporation
Old Hickory, Tennessee

TUBE MILL

1—4x12 Allis-Chalmers Tube Mill, practically new. Silex lining and Norway pebbles.

Priced very low for quick sale.

NASHVILLE INDUSTRIAL CORPORATION
Old Hickory, Tennessee

Thyle Machinery Co.

formerly
A. H. SIMPSON CO.

Rebuilt Machinery

129 Fremont St. — **San Francisco**

FOR SALE OR LEASE

Lead—Silver—Zinc Mine and Mill in the East near Railroad

L. C. BUTLER
26 Water St., Stapleton, S. I., N. Y.

Ores, Metals, Minerals, Oil Lands and Real Estate Bought and Sold

FOR SALE

1—Ingersoll-Rand **Air Compressor.** Type 10. Steam cylinder 20x16; 12x16. Air cylinder 19x16; 11x16.
1—Aldrich **Pump,** 5x9.
2—Deming **Triplex,** 7x8.

Mining and Milling Machinery for Sale Cheap

GEO. H. MURPHY
P. O. Box 192, Boulder, Colo.

DIRECT CURRENT SETS

1—40 kw., 125-v., 320 amp. Sprague Generator, belted type.
1—35 kw., 125-v., 240 amp. Crocker-Wheeler Generator, belted type.

Write for Bargain Price

NASHVILLE INDUSTRIAL CORPORATION
Old Hickory, Tennessee

J. E. KNAPP CO.

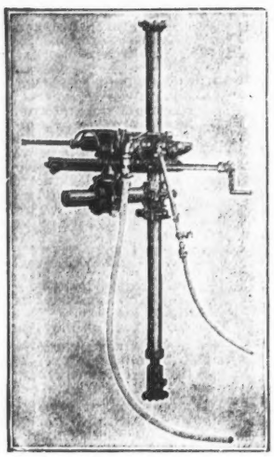
525 Market St. — **San Francisco**

New and Used Mining and Power Plant Equipment

Cochise Drills

"the hard hitters"

2,000 twenty-six pound blows per minute



Four years ago the Chief Consolidated Mining Company Eureka, Utah, had two Cochise Drills in operation. This number was increased until it reached 60 last April—

Now they have 80

Great drilling speed, low air consumption and economical upkeep cost were the determining factors in deciding upon Cochise as against all other drills.

Sold by

Cochise Rock Drill Mfg. Co., Los Angeles, Calif.
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Manufactured by

Cochise
ROCK DRILL MFG. CO., LOS ANGELES, CAL.

Made for maximum service not merely the average

TRADE JENKINS MARK
Jenkins Bros

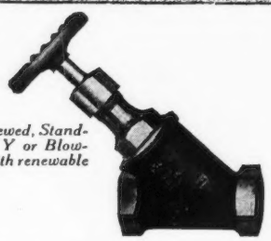

Fig. 124, screwed, Standard Bronze Y or Blow-Off Valve, with renewable seat rings.

Both efficient and serviceable

Jenkins Y or Blow-Off Valves, like all other Jenkins Valves, have two outstanding characteristics that are of vital importance in closely controlling the flow of the fluid handled.

In the first place, they are built heavy and strong and fully c apable of withstanding the severest stresses that may be encountered in actual practice.

Secondly they seat tight when closed, and when open offer as unobstructed a passage to the flow as is practically obtainable.

Valves in bronze, iron and steel, for nearly all requirements. At supply houses everywhere.

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JENKINS BROS., LIMITED
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Always marked with the "Diamond"
Jenkins Valves
SINCE 1864

THERMOLITH
FIRE CEMENT
"Makes the Weakest Point the Strongest"
HARBISON-WALKER REFRACTORIES CO.
World's Largest Producers of Refractories
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A WORLD ORGANIZATION
Completely Covering the Field of Combustion Engineering with Stokers, Pulverized Fuel and Oil Burning Equipment of its own Manufacture.
International Combustion Engineering Corporation
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43 Broad Street, New York
QUINN OIL BURNER GREEN STOKER LOPULCO SYSTEMS

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DEWAR MANUFACTURING CO.
26-32 THIRTY-FIFTH STREET
BROOKLYN, N. Y.

Big Blast Hole Drills For Open Pit Mining

CYCLONE DRILLS

Churn Drills *for* Prospecting *and* Placer Work

THE SANDERSON-CYCLONE DRILL CO., Orrville, O.

THE type B N STANDARD Diamond Drill for underground prospecting is equipped with a three-cylinder engine and is a machine of unequaled rapid drilling power. The engine runs at 1000 revolutions per minute furnishing a steady stream of power, and operates with a minimum of carbon wear.

Gears are furnished adapting it to the hardest or softest rock. This type of STANDARD Drill has a capacity of 600 ft. with 15/16-in. core. Like all Standard Drills it will drill at any angle.

No matter what your prospecting problem, there is a type and size of Standard Diamond Drill that will locate your ore bodies, at low cost.

Established 1901

STANDARD Diamond Drills

Standard Diamond Drill Co.

1st National Bank Bldg.
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Get a Lighter DRIFTER

It isn't necessary for a drifter to be cumbersome and heavy in order to be sturdy and efficient. The Cleveland D5 Drifter is 30 to 60 lbs. lighter than drills of equal power, yet it is just as fast a driller as any made. In fact, it usually outcuts other machines in a contest. Then, think of the greater convenience in setting up and in operating!

But light weight is just one of the advantages of the D5 Drifter. Others are: the powerful blow and rotation, lack of vibration, ease of making steel changes, valve chest integral with cylinder, reversible ratchet ring, and rugged construction throughout to insure long service and lowest possible upkeep.

Get all the facts from Bulletin No. 55

The Cleveland Rock Drill Company
3734 East 78th Street CLEVELAND, OHIO

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Negaunee, Mich.
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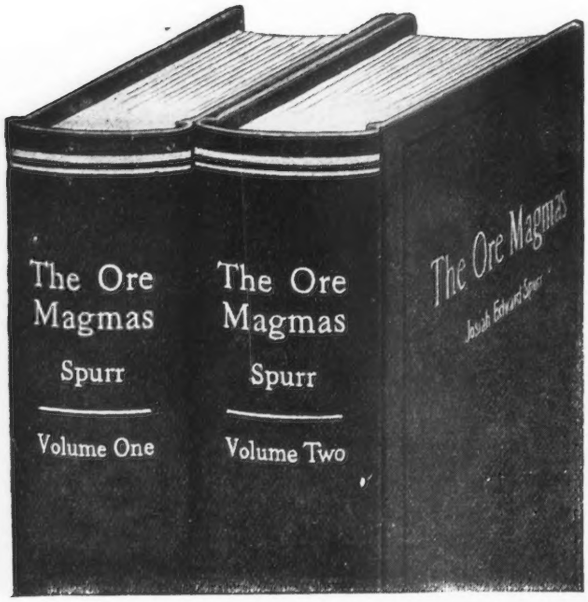
Salt Lake City, Utah
Denver, Colo.
Sacramento, Calif.

The Cleveland Pneumatic Tool Company of Canada, Ltd.
Toronto, Ontario, Canada

Cleveland D5 Drifter



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By Josiah Edward Spurr

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1. The conclusion of the injection of many mineral veins as a dense solution or gelatinous mass, very much as igneous dikes are injected.
2. The conclusion that these ore fluids, or ore magmas, as the author calls them, belong to the class of true magmas, and not magmatic waters, as has been universally conceived.
3. That ores may be in great, definite, straight, persistent belts which have no relation to folding and faulting, and other phenomena of the earth's crust, being of deeper origin.

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They convert idle commodities into useful cash, idle cash into useful commodities, and that which you have but don't want into that which you want but don't have.

The cost is a trifle, the results considerable. 0059

Get Your Wants into the Searchlight

All of this issue having been sold this advertisement appears as a matter of record only

$40,000,000

Andes Copper Mining Company

Convertible 7% Debentures

To be dated January 1, 1925 **To mature January 1, 1943**

Interest payable January 1 and July 1 without deduction for normal Federal Income Tax up to 2%. Coupon Debentures in denominations of $1,000 and $500, registerable as to principal only. Redeemable as a whole or in part on any interest payment date on thirty days, prior notice at 110. Principal and interest payable in United States gold coin at the principal office of

THE NATIONAL CITY BANK OF NEW YORK, Trustee

The Company will agree to reimburse to owners resident in the respective states, upon proper application, the following taxes paid in respect to the Debentures or the interest thereon: the Four Mills Tax in Pennsylvania; any Securities Taxes in Maryland not exceeding in the aggregate forty-five cents on each $100 of assessed value in any year; any Personal Property or Exemption Tax in Connecticut, not exceeding 4/10% of the principal in any year; and any Massachusetts Income Tax, not exceeding in any year 6% of the interest on such Debentures

These debentures will be convertible at the holder's option into shares of Common Stock without par value of the Andes Copper Mining Company at the rate of 44 shares for each $1,000 principal amount of Debentures.

The following information has been furnished by Mr. John D. Ryan, Chairman, and Mr. Cornelius F. Kelley, President, of the Company:

The Andes Copper Mining Company, 99.87% of the Common Stock of which is now controlled by the Anaconda Copper Mining Company, owns a large deposit of porphyritic copper ore located in Chile in the Province of Atacama, about 92 miles east of the seacoast and 200 miles south of Chuquicamata, where the operations of the Chile Copper Company are conducted. The Company has expended during the past eight years nearly $20,000,000 cash in investigation, experimentation and development of the ore body, mining equipment, construction of town, railway lines and port facilities. The proceeds of this issue of $40,000,000 Debentures, as paid in from time to time, will be utilized in the completion of the mining development, construction of the metallurgical plant, railway equipment, to supply working capital for the developed property and for other corporate purposes.

The reserves of proven ore now blocked out, including only that with a copper content of 1% or more, are estimated at 137,400,000 tons averaging 1.51% copper content, consisting of 48,400,000 tons of oxide ore and 89,000,000 tons of sulphide ore. On the basis of the anticipated output of 190,548,000 pounds of copper per annum upon completion of the construction program, these reserves, without including a large tonnage of proven ore of less than 1% copper content and without including undeveloped deposits known to exist in the property, assure an operating life considerably beyond the maturity date of these Debentures.

It is estimated that, upon completion of the development program, copper can be delivered from the mines of the Andes Copper Mining Company to New England points at an average cost, before depreciation, depletion, interest and taxes, of 6.672c per pound. Upon this basis the estimated income available for interest and taxes before depletion and depreciation, on an annual production of 190,548,000 pounds of copper, ranges from $12,057,877 at an average market price of 13c per pound to $21,585,277 at an average market price of 18c per pound. The annual interest charge on this entire issue of Debentures is $2,800,000.

The value of the conversion privilege of the Debentures at various market prices for the stock is indicated as follows:

Market Price of Stock Per Share	Equivalent Value of $1,000 Debenture
$25	$1,100
30	1,320
35	1,540
40	1,760

The Trust Agreement will provide for a Sinking Fund payable semi-annually amounting to 1½c per pound of copper extracted from the property and sold, to be utilized at the option of the Company in the purchase or redemption of Debentures at not exceeding 110. Any conversion of Debentures into stock in accordance with the conversion privilege shall operate as a credit against the Sinking Fund, and all Debentures acquired by the Trustee through the Sinking Fund or conversion shall be cancelled and retired.

INSTALLMENT RECEIPTS

Delivery will be made of Installment Receipts evidencing the payment as of January 1, 1925, of a first installment (25% of principal) on the above described Debentures, which Receipts will be ***exchangeable for such Debentures on July 1, 1926,*** but not prior thereto, upon payment of the remaining installments, when due. The remaining installments (of 25% of principal, each) are payable July 1, 1925, January 1, 1926 and July 1, 1926, respectively. Debentures bearing interest coupons maturing January 1, 1927, and subsequently, will be issued upon the payment, when due, of the final installment. Interest at the rate of 7% per annum, will be paid by the Company, semi-annually, on the first three installments by crediting the amount of such interest against the amounts due on subsequent installments. ***Installment Receipts do not carry the privilege of convertibility into stock, or any other of the rights attaching to Debentures.*** In case of the failure of the holder of an Installment Receipt to pay any installment, when due, the Company, at its option, may cancel the Receipt held by him, and sell the Debenture called for thereby, holding him liable for any deficiency.

We offer these Receipts if, as and when issued and received by us, subject to the approval of our counsel of all proceedings in connection with the authorization of the Debentures and of the Trust Agreement under which they and the Installment Receipts will be issued. It is expected that delivery of interim certificates will be made on or about January 9, 1925.

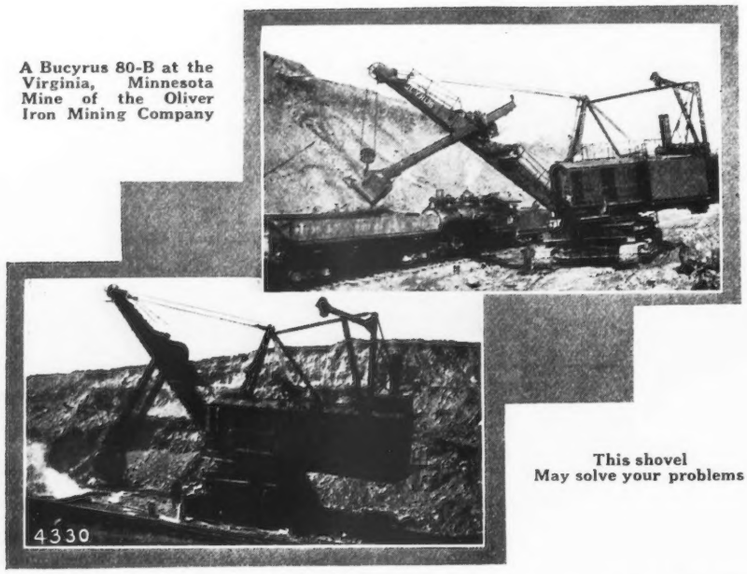
Price par (25% paid) and interest

Application will be made to list the Installment Receipts and the Debentures, if, as and when issued, on the New York Stock Exchange

The National City Company — **Guaranty Company of New York**

Dillon, Read & Co. — **Brown Brothers & Co.** — **Kidder, Peabody & Co.**
Kissel, Kinnicutt & Co. — **Hornblower & Weeks** — **Hallgarten & Co.**
White, Weld & Co. — **Spencer Trask & Co.** — **Hayden, Stone & Co.**
Kean, Taylor & Co — **W. A. Harriman & Co., Inc.** — **Redmond & Co.**
Cassatt & Co. — **Marshall Field, Glore, Ward & Co.** — **Chas. D. Barney & Co.**
Blyth, Witter & Co. — **Edward B. Smith & Co.** — **J. & W. Seligman & Co.**
First National Bank, Boston — **Tucker, Anthony & Co.**
Mellon National Bank, Pittsburgh — **The Union Trust Company of Pittsburgh**
The Union Trust Company Cleveland — **The Herrick Company** Cleveland — **Commerce Trust Company** Kansas City
Anglo London Paris Company, San Francisco — **Bank of Italy,** San Francisco

The above information is based upon official statements and statistics on which we have relied. We do not guarantee but believe it to be correct.



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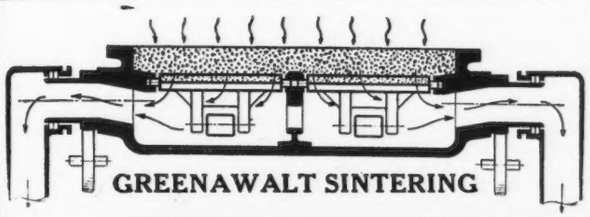

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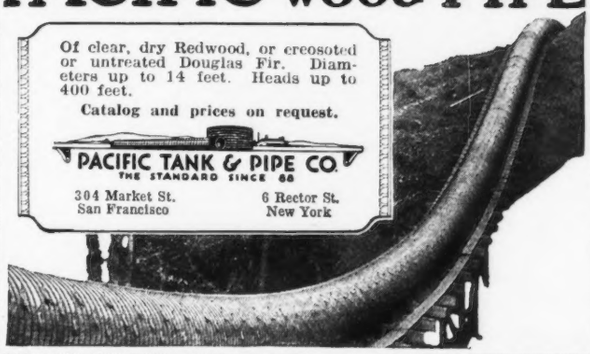

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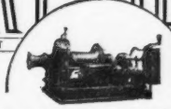

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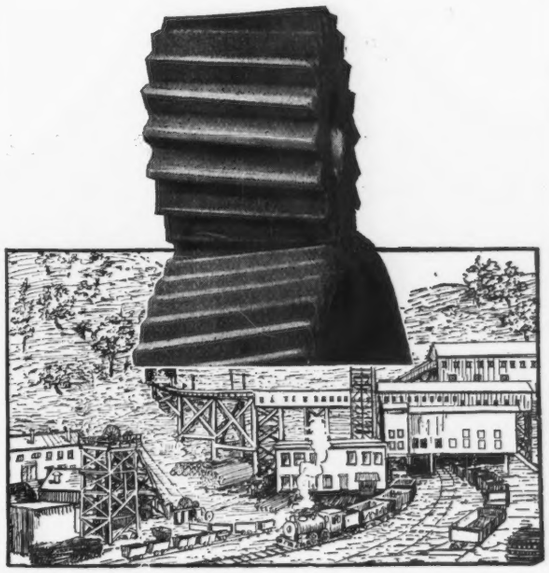

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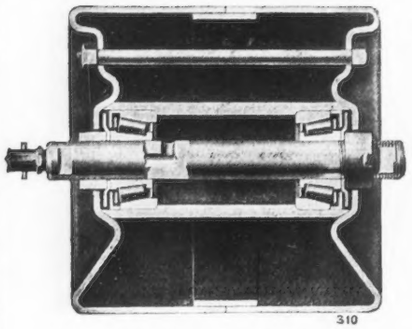

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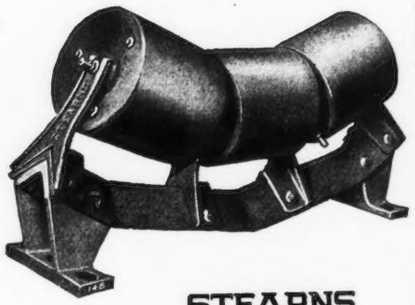

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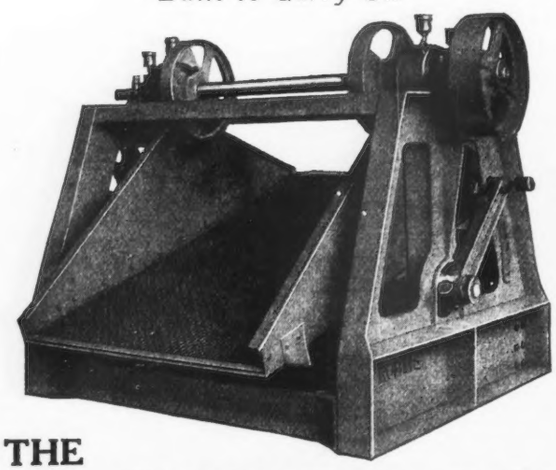

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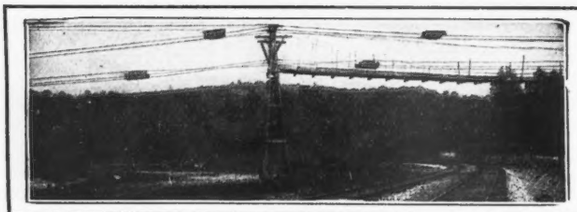

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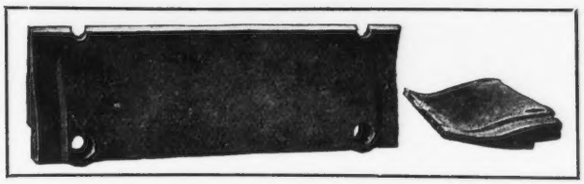

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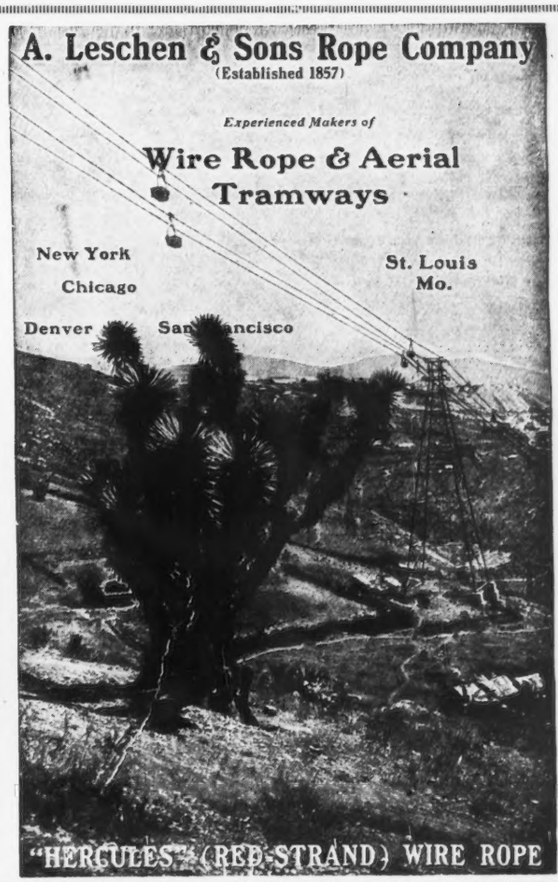

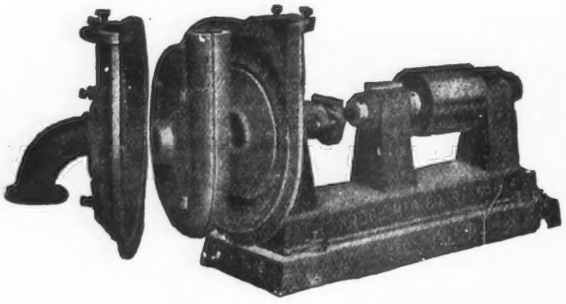

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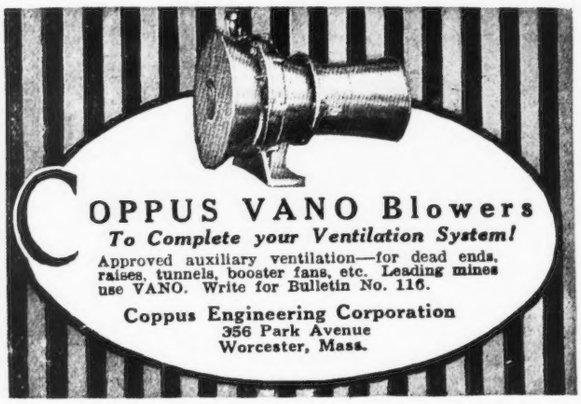

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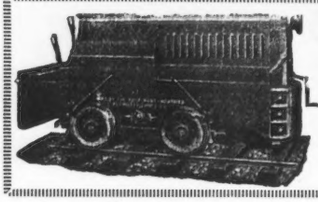

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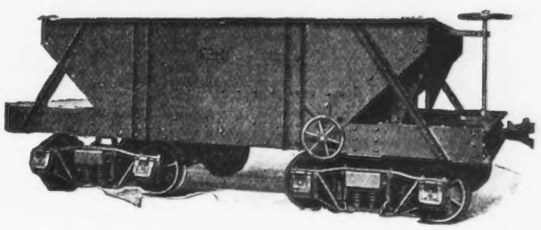

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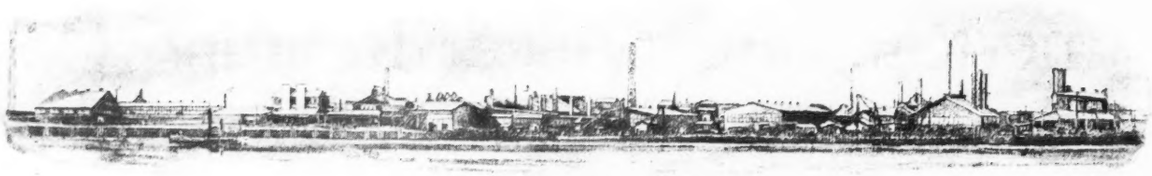

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Drills, Core
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Drills, Diamond
Std. Diamond Drill Co.
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Drills, Hammer
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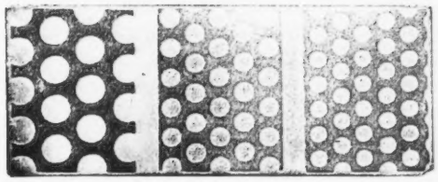

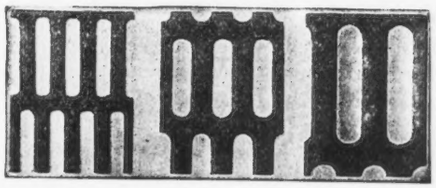

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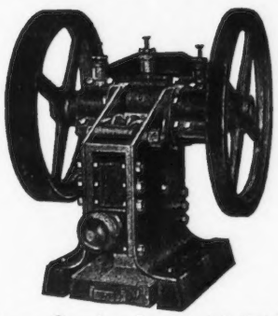

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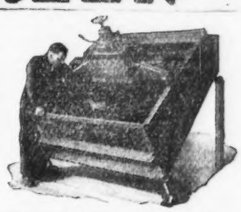

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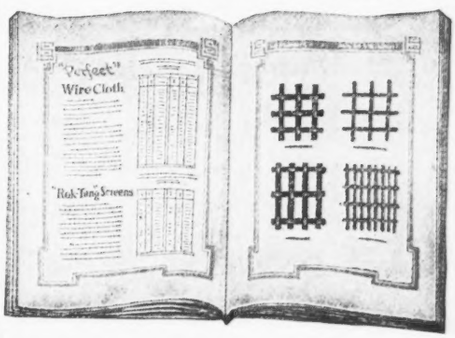

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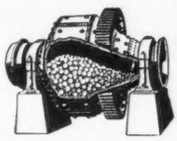

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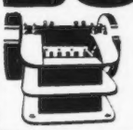

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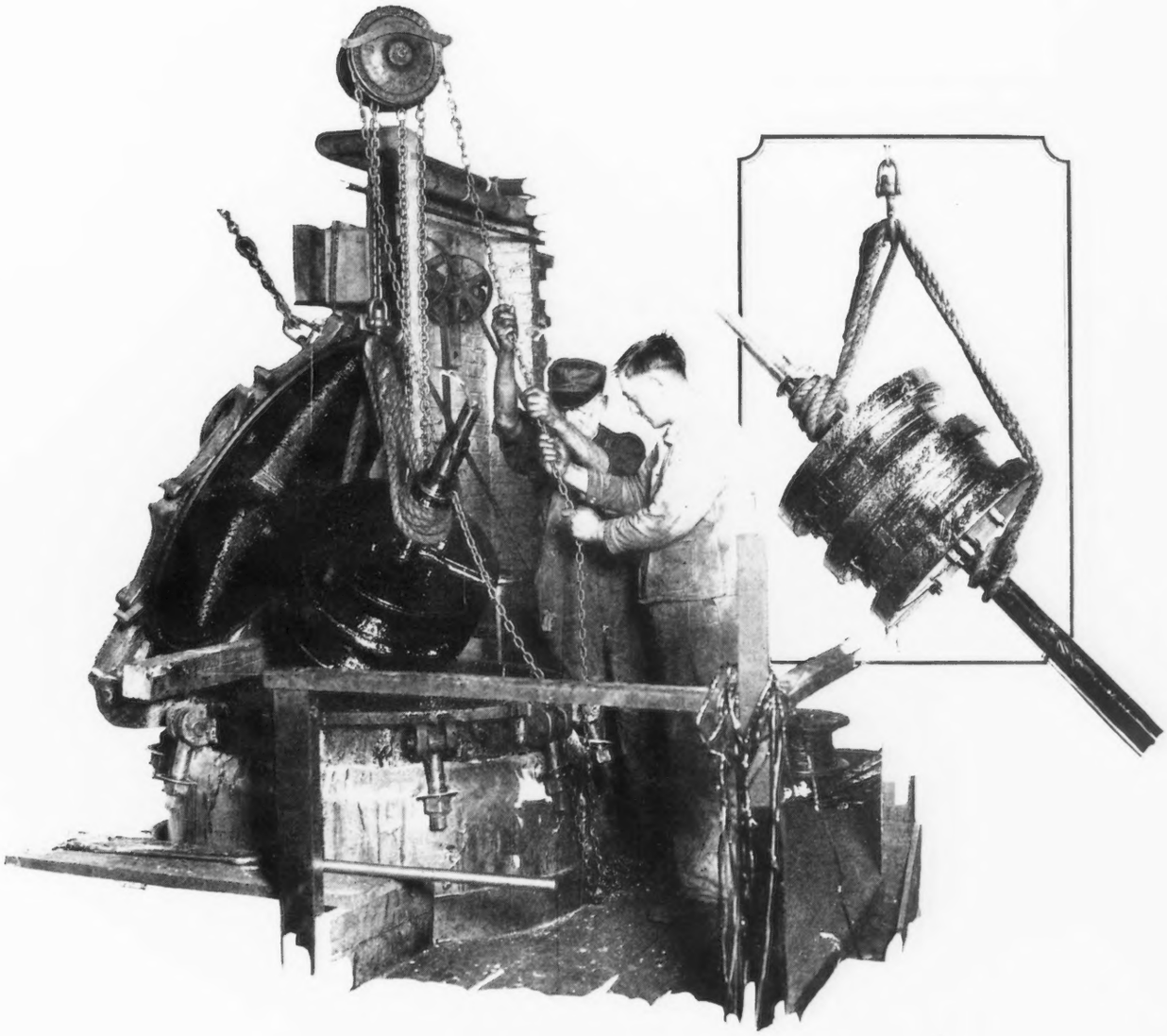

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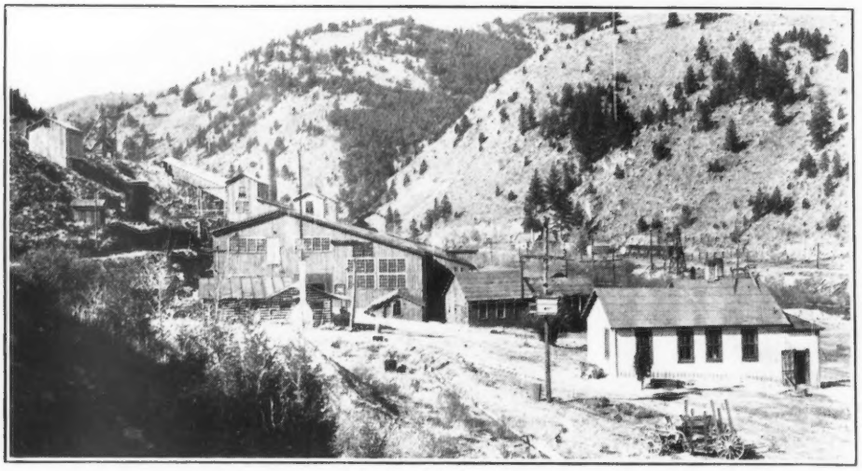

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